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Ancient
VEDIC MATHEMATICS

PUSHP–1

Mathematics with Smile

-: वैदिक गणित सूत्र :-

१ एकाधिकेन पूर्वेण
२ निखिलं नवतश्चरमं दशतः
३ ऊर्ध्वतिर्यग्भ्याम्
४ परावर्त्य योजयेत्
५ शून्यं साम्यसमुच्चये
६ (आनुरुप्ये) शून्यमन्यत्
७ संकलनव्यवकलनाभ्याम्
८ पूरणपूरणाभ्याम्
९ चलनकलनाभ्याम्
१० यावदूनम्
११ व्यष्टिसष्टिः
१२ शेषाण्यङ्केन चरमेण
१३ सोपान्त्यद्वयमन्त्यम्
१४ एकन्यूनेन पूर्वेण
१५ गुणितसमुच्चयः
१६ गुणकसमुच्चयः

By :

DR. NARINDER PURI

वेदात सर्वं प्रसिद्धयति ।

वेद सम्पूर्ण ज्ञान के अनादि अनन्त स्रोत ।

Vedas are the Eternal Source of Knowledge !

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गुरुकुल कांगड़ी विश्वविद्यालय
कृपया पुस्तक के ऊपर कोई निशान आदि
न लगायें।

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पुस्तकालय
गुरुकुल कांगड़ी विश्वविद्यालय, हरिद्वार

वर्ग संख्या 510 आगत संख्या 5956
PUR-A.1

पुस्तक—वितरण की तिथि नीचे अंकित है। इस तिथि सहित २० वें दिन तक यह पुस्तक पुस्तकालय में वापिस आ जानी चाहिए। अन्यथा १० पैसे के हिसाब से विलम्ब–दण्ड लगेगा।

Published by:

SPIRITUAL SCIENCE SERIES,

ROORKEE

Stock Verification-2024

Pushp-I
Ist Edition
English Guru Purnima:
Ashara, Vikrami 2043 (July,1986)

Hindi Independence day:
Shravan, Vikrami 2043 (Aug.15,1986)

2nd Edition
English and Hindi Guru Purnima:
Ashara,Vikrami 2045 (July, 1988)

Pushp-II
1st Edition
English National Youth day:
Swami Vivekananda's Birthday
Vikrami 2044 (Jan. 12,1988)

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R
510
PUR-A1

Published by :

Mrs. Meenakshi Puri
for Spiritual Science Series
41/2, Amod Kunj.
University of Roorkee.
Roorkee-247667 (U.P.)
INDIA

Printed at:->

Jugnu Printers,
Naveen Shahadra,
Delhi-110032

Price Rs.20/=
Delux Rs30/=

THE SIXTEEN SUTRAS OF VEDIC MATHEMATICS

सूत्र :-

१ एकाधिकेन पूर्वेण	1. Ekadhikena Purvena (also a corollary)
२ निखिलं नवतश्चरमं दशतः	2. Nikhilam Navatascaramam Dasatah
३ ऊर्ध्वतिर्यग्भ्याम्	3. Urdhva-tiryagbhyam
४ परावर्त्य योजयेत्	4. Paravartya Yojayet
५ शून्यं साम्यसमुच्चये	5. Sunyam Samyasamuccaye
६ (आनुरुप्ये) शून्यमन्यत्	6. (Anurupye) Sunyamanyat
७ संकलनव्यवकलनाभ्याम्	7. Sankalana-vyavakalanabhyam (also a corollary)
८ पूरणपूरणाभ्याम्	8. Puranapuranabhyam
९ चलनकलनाभ्याम्	9. Calana-Kalanabhyam
१० यावदूनम्	10. Yavadunam
११ व्यष्टिसष्टिः	11. Vyastisamastih
१२ शेषाण्यङ्केन चरमेण	12. Sesanyankena Caramena
१३ सोपान्त्यद्वयमन्त्यम्	13. Sopantyadvayamantyam
१४ एकन्यूनेन पूर्वेण	14. Ekanyunena Purvena
१५ गुणितसमुच्चयः	15. Gunitasamuccayah
१६ गुणकसमुच्चयः	16. Gunakasamuccayah

-: VEDIC MATHEMATICS SUTRAS :-

1. By one more than the previous one
2. All from nine & last from ten
3. Vertically & Crosswise
4. Transpose & Apply
5. The summation is equal to zero
6. If one is in ratio, the other one is zero
7. By addition and subtraction
8. By the completion and noncompletion
9. Sequential motion
10. The deficiency
11. Whole as one & one as whole
12. Remainder by the last digit
13. Ultimate and twice the penaltimate
14. By one less than the previous one
15. The whole product is the same
16. Collectivity of multipliers

VEDIC MATHEMATICS SYSTEM

Whatever we see in nature has a perfect mathematical structure.The rotation of the earth, movement of the stars and planets, growth of the plants and trees etc.are all perfectly mathematically structured.The blooming of a flower, the growth of a plant, the rotation of the earth, all go on so very effortlessly.Recent research is bringing to light the perfect mathematical structure of the Vedic texts. As a matter of fact whatever we do in life has mathematics in some form or the other. It is not possible to prepare even a delicious cup of coffee without a precise sense and application of mathematical proportion of different ingredients used. It's a pity that such a wonderful subject of fundamental and vital importance -mathematics -is creating the problem of 'MATHS ANXIETY' in all parts of the world. The common students are afraid of Mathematics. The gravity of the problem is quite clear from a recent survey report published in America. The top 10% of the students of Maths were asked the question, "Do you like Mathematics" ,And 60% of them said No. The answer of the remaining 90% is quite obvious.

Further, whatever we want to do, we always have a large number of alternatives and choices in doing the same.How strange that in Mathematics there seems to be almost no choice, and, most of the time we have to follow a unique, fixed, monotonus, often boring and tedious procedure in whatever arithmetical operation we want to do. Interestingly enough this unique aproach is considered to be a quality by some mathematicians. Anything fixed, naturally becomes monotonus and boring and Maths Anxiety is the natural result. Vedic Maths on the other hand with its multiple choices makes maths a playful and interesting subject, which naturally brings frequent smiles on the face and joy in the heart of the students.

The sixteen Vedic sutras provide a structured system which is applicable in, and, hence, is capable of explanining almost any facet of cosmos,both at abstract as well as applied level.These sutras in their philosophical interpretation even explain the functioning of human psychology. In their simple applied form, their crude translation in English has been presented in the beginning.

Sanskrit is a rich language and for deeper meaning one has to dive deep into the original sutras. The first Vedic Sutra Ekadhiken Purvena in simple English means by one more than the previous one, and a couple of very interesting and wonderful applications are presented in Pushp I. However the same sutra Ekadhiken Purven ( ) explains the whole concept of growth and development of an individual, society or any facet of knowledge. The word purven essentially means the previous state. Ekadhiken means one higher than (the previous state). The higher state again becomes the previous and we go higher and higher and higher step by step, and that speaks out the whole process of growth and development. Similarly each sutra has a deep philosophical meaning. However, in the initial Pushps we are only looking at the simple applied facets of these sutras.

प्रात: प्रभृति सायान्तम्
सायन्त. प्रातरन्तम्
यत् करोमि जगन्नाथ
तदस्तु तव पूजनम्

सुबह से शाम तक, शाम से सुबह तक,
मैं जो कुछ भी करता हूँ, हे जगन्नाथ
सब तेरी ही पूजा, तेरी ही उपासना हो जाए।

From morning till eve,
And evening till morn,
Whatever I do ,
Oh, Lord of Universe
Let that be my prayar of thee !

* * * * * * * * * * * * * * * *

Dedicated to

Jagad Guru Shankara Charya
Swami Bharati Krishen Tirathji Maharaj

* * * * * * * * * * * * * * * * * * *

Vedic Mathematics provides very easy, one line, mental and superfast methods alongwith magic speed cross checking system. As such Vedic Maths is a boon for all competitions. Vedic methods are easy to understand and their variety, speed and ease brings joy in the heart and smile on the face of the students. The Vedic Maths always provides a general method which is always faster than the present system but Vedic system also provides various other methods which often work with magic speed and very frequently the students of Vedic maths class move faster than the teacher and speak out the answer before they are written on the black board.

Prof. K.R. Williams of London says, "This element of choice in the Vedic System, even of innovation, together with mental approach, brings a new dimension to the study and practice of Mathematics. The variety and simplicity of methods brings fun and amusement, the mental practice leads to a more agile, alert and intelligent mind and innovation naturally follows".

SWAMI BHARATI KRISHNA TIRTHA

Swami Bharati Krishna Tirtha, author of the first recent Vedic Mathematics book was the Shankaracharya of Goverdhan Peeth. Jagadguruji, named Venkatraman in his early days, was an exceptionally brilliant student and invariably won the first place in all the subjects in all the classes throughout his educational carrier.

After winning the highest place in the B.A. examiation, Shri Venkatraman Saraswati appeared at the M.A. examination of the American college from Bombay Centre in 1903. In 1904, at the age of just twenty, he passed M.A. examination in further seven subjects simultaneously securing the highest honours in all, which is perhaps the all time world-record of academic brilliance. His subjects included Sanskrit Philosophy, English, Mathematics, History and Science.

In the words of Swamiji,

"The Sutras (aphorisms) apply to and cover each and every chapter of each and every branch of mathematics (including arithmatic, algebra, geometry- plane and solid, trigonometry -plane and spherical, conics- geometrical and analytical, astronomy, calculus etc. etc.). In fact, there is no part of mathematics, pure or applied, which is beyond their jurisdiction. The Sutras are easy to understand, easy to apply and easy to remember; and the whole work can be truthfully summarised in one word "mental",".

PREFACE

Ist Edition

Vedas are the source of all knowledge and of all Sciences. They are not only the oldest but also the best. The Vedas have guided millions of aspirants on the path of knowledge. With the passage of time most of the Vedic knowledge has been scattered and shattered. Vedic Mathematics is no exception to it. It is inspiring to observe that, deep interest is being taken, the world over in reviving the Vedic Sciences.

There are very few persons who are experts in so many facets of knowledge. Srimat Swami Bhartiya Krishna Tirth Ji was a personality of that rare talent. Touched by the remark 'A mistake in Vedas - about the crisp -'Ganit Sutras in Vedas; he resorted to the age old Vedic method of meditation. He authored 16 volumes, but only the rewritten introductory volume is available, to inspire and guide the real seekers of knowledge. My humble pranams at his holy feet.

Every body who has learnt a little about the Ancient Vedic Mathematics has shown a great enthusiasm to learn more. The interest and response of the students have inspired us to link-up the available bits here and there.

The real beauty of the Ancient Vedic Mathematics is that as you start using this system, new links automatically come to the mind. A large number of persons, mostly students, from remote corners of mother India have helped me in reviving the new links. (The chapters 2,3,4,5,6 and 11 are beyond the basic book).

We are trying to put the already revived links in a serialised form which may be easily learnt by the students and teachers alike. The write up has become rather long, at places, even for simple topics. But once learnt and practised, the actual operations can frequently be performed with a superfast speed. The limitations and criticism may kindly be freely conveyed, for improvement in future.

This whole project is being done with the spirit of 'Jnyana Yajna'. Thanks are due to a large number of selfless workers for their labour of Love. I would like to specially thank Dr. P.S. Misra, Sh. Bodh Swarup Pandyal (Nepal), Dr.Ramchander, Kumari Maya, Divya and Shruti.

Dear Vinay Kumar Mittal took the press work on his shoulders, with a smile, and Meenakshi has always inspired me.

May the students enjoy this Ancient Vedic gift, which makes mathematics a fun, rather than a burden.

PREFACE - SECOND EDITION

Just like the superfast speed of working of Vedic Mathematics, it is spreading around the whole world with the unimaginable speed. Vedic Maths is being received with a great hope, joy and smile in all parts of the world. With the regular practice of the most natural mental procedures of Vedic Maths system, the HOLLISTIC DEVELIPMENT of THE HUMAN BRAIN automatically takes place. The very natural, easy and superfast algorithms of Vedic Maths bring an upsurge of joy and bliss. Due to very special and universal features, Vedic Maths system converts the dry and tedious Maths into a playful and joyful subject which children learn with smiles. Therefore the Vedic Maths is the gift of the Veda to solve the problem of "MATHS ANXIETY" being faced in Maths education in the whole world.

It is a matter of great joy that the members of Maharishi International Organisation are translating the Vedic Mathematics PUSHPMALA in 36 foreign languages.

I pray to the Divine that this gift of the Veda may help you to develop intution capability.

N.PURI

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"ANCIENT VEDIC MATHEMATICS"

SALIENT FEATURES

A Complete System

Ideal for Hollistic Development of Human Brain

- 16 Vedic sutras of 120 words can solve all mathematical problems.
- With a firm scientific footing
- A revolution in concept of learning
- Opening new areas of R & D
- The Vedic Maths can be used to check the computer results, and frequently supersedes calculators.
- Revealing hither-to-unknown,Great and Mysterious Qualities of Numbers.
- Simple, short mental mathematical processes often with magic speed.
- Requires no prerequisite courses
- Mathematics otherwise burden, turns to be a joyful and playful subject.

With multiple choice procedures

A boon for all competitions like Banking, Engineering, Medical, Economics, UPSC, ONGC, MBA, etc., where the use of calculator is not allowed.

More useful, accurate and applicable at times, compared to modern computers.

2 hours/day for 16 months equals 12 years of normal course in Mathematics in India and abroad.

VEDIC MATHEMATICS NEWS

"It is tempting to think of them (Indians) as computer scientists ...."Let us not forget that among the great accomplishments of the Indian thinkers were the invention of zero, and of the Binary number system a thousand years before the West". Dr. R. Briggs of NASA, California, in Jl. of Artificial Intelligence, Spring, 85.

It is interesting to note that this Ancient Indian Binary number system is used in all the calculators and computers of the world without exception.

1. The first book on Vedic Mathematics was written by H.H. Swami Bharati Krishen Tirth Ji, Shankaracharya of Puri (1884-1960) in English. This book is already running in 10th reprint in last 20 years. It has already been translated in Marathi in 4 volumes and Gujrati in 3 volumes. Further, it is being translated in Hindi, Latin and German.

2. The Symposium and Workshop have been organised at Nagpur, London, Roorkee and B.H.U. Varanasi in 1985, 1986 and 1987 respectively. Further, workshops and seminars have been organised in by June 1988 at Rohtak, Pantnagar, Jaipur, England, U.S.A., Mexico, Norway, Swedon, Denmark, Hungry, Italy, Spain, France, Germany, Switzerland and Holland.

3. The 'Vedic Mathematics is being taught at the School of Economic Science London, James School, St. Vedast School London, Mary Ward Centre, School of Philosophy Australia and Auckland, and several other institutions in USA,Australia and Holland etc.

4. Swami Ji's book introduces the wonderful applications to Arithmetical computations, theory of numbers, compound multiplications, algebraic operations, factorisations, simple quadratic and higher order equations, simultaneous quadratic equations,partial fractions, check, squaring, cubing, square root, cube root, coordinate geometry and the wonderful Vedic Alpha-Numerical code.

5. Currently a course is being run in London demonstrating that 'Vedic Methods' can be used for G.C.E. A-level mathematics. This is a pilot project, being held at the Mary Ward Centre, in association with the Polytechnic of North London. This is equivalent to our 10 + 2 level in India.

6. On this noval Indian system of Mathematics pioneering work is being done in U.K. The research includes applications of Vedic Mathematics to trigonometry, three dimensional coordinate geometry, solution of plain and spherical triangles, linear and nonlinear differential equations, matrices and determinants, and log and exponentials.

7. The most interesting point to note is that the Vedic Mathematics provides unique solution in several instances where only

trial and error method is available at present. For example the Kepler s equation can be solved in just 90 seconds as compared to the present tedious trial and error method, which takes nearly half an hour.

LIST OF NEW BOOKS ON `VEDIC MATHEMATICS

1. `Introductory Lectures on Vedic Mathematics', by A.P. Nicholas, J.R. Pickles and K.Williams
2. `Discover Vedic Mathematics', By K.Williams
3. `Triples , by K.Williams (A research book)
4. `Vertically and Crosswise', by A.P. Nicholas, K.Williams and J.R. Pickles
5. `Vedic Ganit' by Dilip Kulkarni in Marathi,4 parts
6. Vedic Ganit in Gujrati, 3 parts
7. Vedic Ganitam, by T.S.Raju
8. Notes of Workshop on "Vedic Mathematics and its Computational Potentialities" based on advanced research in U.K., G.Editor N. Puri (English)
9. Ancient Vedic Mathematics -PUSHP-I and PUSHP-II by N. Puri (Hindi/English). The only book available in Hindi
10. Maths or Magic by J House
11. Glimpses - Vedic Maths, by N. Puri (Hindi/English)
12. Workshop on Vedic Mathematics by Dr. N.Puri at B.H.U. Varanasi, Dec. 1987
13. Overview of Vedic Mathematics by Dr. N. Puri; Workshop on Vedic Mathematics, at University of Rajasthan, Jaipur sponsored by Ministry of Education, Govt. of India.
14. Lecture Notes of Elementary Vedic Mathematics, by Dr. N. Puri held at Switzerland in June, 1988
15. Vedic Mathematics three month correspondence course, Part I Dr. N. Puri
16. Vedic Mathematics three month correspondence course, Part II Dr. N. Puri

Note: All books are available from SSG.Send Rs.2/- for full details.

WORK AT ROORKEE

The Spiritual Study Group consisting of the students and staff of Roorkee University has initiated humble efforts towards the research, development and spreading of this wonderful mathematical facet of our rich, vast and scientific cultural heritage.

Video Cassettes: A series of Video cassettes of Lectures on different facets of Vedic Mathematics are being produced in different parts of the world. These are available on sale. The interested persons or institutions may send Rs. 10/- for full details of contents of each cassette, rules and regulations of purchase system etc.

Lectures: Thousands of Vedic Mathematics demonstration lectures are being delivered in different parts of the world. In India, hundreds of lectures have already been given in Delhi, Punjab, Gujrat, West Bengal, UP, MP, Karnatka, Kerala, A.P., Goa, Rajasthan, Hariyana and Maharashtra. Further, demonstration lectures and seminars on Vedic mathematics have already been delivered in several cities of America, England, Canada, Mexico, Norway, Sweden, Finland, Denmark, Hungry, Germany, Italy, Switzerland, Spain and Holland in the recent past.

Courses: Starting with the first course in May, 1985 SSG has already organised VM courses for 39 batches attended by 4300 participants ranging from school children, teachers, university students, research scholars, field engineers to the professors of the universities by June, 1988. All of them enjoyed learning the simple magic speed methods of solving the otherwise tedious mathematical calculations.

Institute of Vedic Sciences-Correspondence Course

On repeated requests from persons residing outside Roorkee, the correspondence course for home study of the wonderful and magic speed 'Vedic Mathematics' has been started from the auspicious Maha Kumbh, Baisakhi (April 14, 1986). With a view to revive the ancient sciences, SSG has started the Institute of Vedic Sciences at Roorkee. Presently the institute is organising correspondence courses of six months duration in Hindi and English. New batches start from auspicious Baisakhi (April) and Dushera (October) every year. Correspondence courses are also being started in different countries.

Anybody who is in class VIII and above can join these courses. Fortnightly lessons, containing a large number of solved problems, and examples are sent to every participant. The students are asked to submit solution of the problems, which are duly checked. A certificate is awarded at the end of the course, after a postal test. The detailed information, course content, glimpses of Vedic Maths. etc. are available for Rs. 10/- (Further add Rs. 5.00 if desired by registered post) for India and $ 3 for other countries.

WORKSHOP

A symposium on Vedic Mathematics was held in Feb. 1985 at Nagpur.The second at Bhartiya Vidya Bhawan's London centre in Sept. 1986. The first 11-day workshop on Vedic Maths and its computational potentialities was held at University of Roorkee in Aug. 1987.Further Vedic Maths workshops have been organised at BHU Varanasi,Pantnagar University, Rajasthan University, Jaipur, Delhi and Bangalore. Recently, Vedic Maths seminars have also been held (during April,1988) at Imperial College, London; Oxford University, Cambridge University, and Ideal Village, Lancashire; Washington; Sidewell Friends School, Washington; Harward University, Scientific systems, Boston; Annual NCTM meeting at Chicago; Los Angles; Stanford University, Pola Alto; University of California, Berkley; Indiana; Goldendome MI University, Fairfield; Toronto; Mexico University, MIU Oslo, Academy at Liley Hamer,Norway, Upsala University and Stockholm University, Sweden; Turku University, Finland; Copenhagen University and H.C. Oersted Institute ,Denmark; Hemberg University and Technical University Berlin; Institute of Leadership Budapast ,Hungry. Further during the month of May,1988 Vedic Maths seminars were held at Main University Vienna, Austria; TM Centre Rome; Engineering faculty University of Naples and University of Milan, Italy; MERU Seelsberg, Geneva University, Switzerland; Paris University,France; Barcelona; Spain, MERU Vlodrop, Amsterdam University, Holland.The first International trainers training programme of Vedic Mathematics teachers is being organised at MERU Seelsberg Switzerland for a period of two weeks during June-July,1988. Further courses are being planned in America and other parts of the world in near future.

Ancient Vedic Mathematics:

With a view to provide the comprehensive details of this wonderful, Ancient Bhartiya Cultural Heritage, SSS is planning to publish a series of books called Pushpmala.

SSS most prayerfully and humbly has published this Pushp-I and IIin English & Hindi. Pushp-3 shall be published soon.

Ancient Vedic Mathematics New Links

As a result of the humble research efforts of the members of SSG, a few of the missing links of the Ancient Vedic Mathematics have already been revived.Specifically the superfast Vedic methods of addition, subtraction, compound addition and subtraction, tables,compound multiplication, extensions of the base system for multiplication, multiplication of three or more numbers in one line squaring of very large numbers, the magic speed methods of checking the correctness of any arithmetic or algebraic addition, subtraction, multiplication, division, factorisation, etc.have already been re-established. Many of the new links alongwith multiplication, division, fractions etc.are being published in Pushp-I and II.Further links shall be published in future Pushp mala.

Opinion of the Participants:

Everybody who has learnt a little about the Vedic Mathematics has been thrilled by the superfast, almost magic speed calculation procedures of the Vedic Mathematics. The Spiritual Study Group at Roorkee has been organising Elementary and Advance courses on Vedic Mathematics, since May,85. All the participants are asked to fill up the response forms comparing the present system of Mathematics with the Vedic system. A total of 11 questions were asked.The minimum score in favour of Vedic Mathematics for any question in any course so far was 80%. Most of the questions got 100% favour. Further, comments of participants are motivating and inspiring for spreading Vedic Maths.

A few glimpses of the participants opinions:

- A boon for all competitive examinations
- Could never imagine it would be so interesting
- Very pleasant to have this course at the university
- How advanced our ancestors were even in Mathematics
- If Vedic Maths was taught in every school, computers would have developed in India
- Excellent course
- Want to learn advanced topics
- Increases devotion towards our INDIA and its ancient culture
- Now I wish to learn Sanskrit to know more about our ancient scientific developments
- Every person on earth should have the knowledge of Vedic Mathematics
- It was a boon to learn Vedic Mathematics in Dushera holidays (I had planned for my regular studies)
- Want to learn more about Vedic Mathematics like factorisation etc. which are difficult in modern system
- Amazing speed, very wide applications covering almost all the mathematical operations
- A dynamic stepfor its introduction in educational system is a must
- Has created an interest to know more about it
- It can be of great use for children if made part of syllabus

Mysterious nature of numbers.After little practice problems can be mentally solved at magic speed

Very educative, has much scope for coming generation to start its practice from beginning

It is a strong proof of our rich cultural heritage

By Vedic methods Maths , which is a burden, becomes a joy for the children

This is the most interesting and thrilling time of my life. Being a mathematics teacher I have interest in maths, but this Vedic Mathematics has thrilled me. When I come in contact with the vedic Mathematics it gave such a pleasure which I can't explain in words

A teacher of University Adarsh Bal Niketan

The lectures were eye openers and most thrilling

A glimpse of the lofty trakking in Himalayas of ancient knowledge in Maths,developed with spiritualsm. Cudos to SSG.

A professor of University

CHAPTER-1

BASE SYSTEM

In Vedic Mathematics the base system is very frequently used to reduce the computations involved. The base is considered to be the powers of 10. For example 10, 100, 1000, 10,000 and so on are the different bases.

Deviation from the Base:

1. We should take, as base, for our calculations, that power of 10 which is nearest to the number.

2. For the numbers more than the base, the portion of the number exceeding the base is written with a +ve sign in front of the number.

3. For the number below the base, we subtract the number from the base and write down the remainder in front of the number with a -ve sign. This deviation is directly written by using the Nikhilam Sutra. (Sutra No.2). The Sutra means all from 9 and last from 10.

Examples:

1.1 Say number is 103.

The base is 100 and the number is 3 more than the base.
Therefore, 103 is written as 103 + 03

1.2 Say number is 115.

The base is 100 and the number is 15 more than the base.
Therefore, 115 is written as 115 + 15

1.3 Say number is 1012.

Now base is 1000 and the number is 12 more than the base.
Therefore, 1012 is written as 1012 + 012

1.4 Say number is 13.

This time base is 10 and the number is 3 more than the base.

Therefore, 13 is written as 13 + 3

1.5 Say number is 10004.

This time base is ...and the number is..... more than the base.

Therefore.... is written as ...:....+.......

1.6 Say the number is 9.

The base is 10 and 10 - 9 gives a remainder of 1, therefore 9 is one below the base 10.

The number 9 is written as 9 - 1

1.7 Say the number is 92.

The base is 100 and the number is 8 less than the base.

Therefore 92 is written as 92 - 08

1.8 Say the number is 991.

The base is 1000 and the number is 9 less than the base.

Therefore, 991 is written as 991 - 009

By Nikhilam Sutra we get 9 - 9 = 0. 9 - 9= 0 and 10-1=9

Therefore deviation = - 009.

1.9 Say the number is 75.

The base is 100 and the number is 25 less than the base.

Therefore, 75 is written as 75 - 25

1.10 Say the number is 971.

The base is 1000 and the number is 29 less than the base.

Therefore, 971 is written as 971 - 029

By Nikhilam Sutra we get 9 - 9 = 0; 9 - 7=2; and 10 - 1=9

Therefore deviation = -029.

1.11 Say the number is 975.

The base is ... and the number is .... less than the base.

Therefore ......is written as ....

Note: If the difference of the number from the base is very large, a suitable sub-base (or working base) can also be used.
The sub-base is a convenient multiple of a suitable base. For example the number is 41. If we take a base of 10, it is 31 more than 10. If we take a base of 100, it is 59 less than 100. Therefore, it shall not be convenient to use a base of 10 or 100 and a working base shall have to be used. (To be explained later on, in subsequent chapters).

PROBLEMS:

Q.1 Decide the appropriate base for the following numbers and rewrite these numbers in the Vedic base system style:

(a) 107 (b) 12 (c) 97 (d) 19 (e) 112 (f) 9/5

(g) 10008 (h) 89 (i) 75 (j) 29

Q.2 The bases for the following numbers have been decided as indicated below and the number is written in the Vedic base system style.

Indicate the mistakes and rectify them.

	Number	Base	Vedic style	Remarks & corrected form
(i)	111	100	111 + 11	
(ii)	6	10	6 - 4	
(iii)	97	100	100 - 3	
(iv)	107	100	100 + 3	
(v)	992	1000	992 + 8	
(vi)	9972	1000	1000 - 22	
(viii)	10025	10000	10025 - 25	

Q.3 The correct base for some numbers is listed below. The deviation of the numbers from the base is also given. Write down the actual numbers. Also write these numbers in the Vedic base system style.

	Base	Deviation	Correct Number	Vedic style
(i)	10	3	13	13 +3
(ii)	10	-3		
(iii)	100	-7		
(iv)	1000	14		
(v)	1000	-19		
(vi)	100000	-31		
(vii)	1000	+374		

CHAPTER-2

TABLES

2.1 INTRODUCTION :

Nikhilam Sutra – this is the second sutra. Using this sutra we can very conveniently perform multiplication of numbers consisting of very large or small digits. In this process the Vedic Base System is used.

The simple meaning of this sutra is all from 9 and last from 10. This sutra is used to straight away write down the deviation of the numbers from the base for the numbers smaller than the base. Let us take an example.

Illustration 1

Say the number is 9856. The base (i.e. the multiple of 10) close to the number is 10000. The Nikhilam sutra which reads Nikhilam Navtashcaraman Dashatah tells us to subtract each digit of the number from 9 and the last digit from 10.

Therefore for given number 9856 the digit by digit deviation is obtained as
9 – 9 = 0, 9 – 8 = 1, 9 – 5 = 4 and the last digit of the deviation is 10 – 6 = 4. Hence the deviation is –0144 and in the Vedic Base System we write it as

9856 – 0144

Similarly 937 is written as

937 – 063

73 is written as 73 – 27.

Illustration 2

If the given number is larger than the base or sub-base we write down the deviation with a positive sign as already explained.

Discussion

This is very useful for multiplying the numbers which are closer to the base or a suitable sub-base. As the process of multiplication is simply reduced to the multiplication of the deviations and simple algebraic addition. But before taking the details about the same we shall see how this approach of Vedic Mathematics makes the whole process of number tables a very easy affair. As a matter of fact we shall presently see that there is no need to remember tables beyond 5 x 5 as anything beyond can be simply split down to the level of 5 x 5. The idea is not to say that one should not remember the tables but it is not essential to mug-up the tables.

5956

2.2 TABLES

The Vedic method gives us the key which works superfast not only upto tables of 20 but is equally efficiently applicable to any table even upto 100 or more.

Illustration 3:

Let us take the table of 19 as our first example. The operator is -1 for the unit place and +2 for the tenth place.

(i) That means we write the number 19 and divide it into two parts by drawing a vertical line in between the two digits.

(ii) We apply the operator to the digit at the unit place (with appropriate sign - of course). In the present example we apply the operator -1 to the digit 9 (at the unit place) and therefore we get 9 - 1 = 8 as the second level unit number, 8 - 1 = 7 as a third level digit, 7 - 1 = 6 the fourth level 6 - 1 = 5 as the fith level and so on, finally 1 - 1 = 0 at the tenth level. However, if required, the carry over can be easily done.

This step gives us the digits of the unity column 1.

(iii) Next we apply the operator of the tenth place to the digit at the tenth place. Presently, we add +2 at every stage to get the tenth place number at the next level. Therefore, we get 1 + 2 = 3 as the digit at the second level. Similarly moving further, 3 + 2 = 5 is the third level digit, 5 + 2 = 7 is the fourth level digit 7 + 2 = 9 the fifth level, 9 + 2 = 11 as the sixth level digit, 11 + 2 = 13 as the seventh level digit and so on, 17 + 2 = 19 at the tenth level.

1	9
	8
	7
	6
	5
	4
	3
	2
	1
	0

R
510
PUR-A.1

Notes:

1. However it is not essential to stop at tenth level as the same operators can be further applied for continuing to write the table upto hundredth level or even more if so desired.

2. As soon as the operation of addition gives the value larger than 9, the unity at the tenth place of addition (which shall be actually at the hundredth place of the final number) we can leave in the addition process and add only to the single digit left over.

level		
1	1	9
2	3	8
3	5	7
4	7	6
5	9	5
6	11	4
7	13	3
8	15	2
9	17	1
10	19	0

Illustration 4:

Before we discuss the simple step-by-step process of establishing and identifying the operator key numbers for writing the tables. let us take another example of the table of 89. This number being closer to the base of 100 (with three digits in the base) we require three operators. It may be surprisingly interesting to learn that the rather simple operator numbers for this table of 89 are -1, -1 and +1 for the unity, tenth and hundredth place respectively.

Step 1: Once again we divide the number 89 into three parts by drawing two vertical lines, one between the two digits and the second before the tenth place digit.

Step 2: As before we apply an operator with appropriate sign to the unit place digit. Therefore we get 9 - 1 = 8 as the second level number, 8 - 1 = 7 as the third level etc., 1 - 1 = 0 as the tenth level. We may be interested to go even beyond tenth level. Now our unit place digit at the tenth level is 0. Therefore we simply carry 1 from the tenth place and get 10 (to be operated upon). However we also record -1 in front of the level after which the carry over had to be done. (in the present example, we put -1 in front of the eleventh level). Therefore, the unit number of the eleventh level is 10 -1 =9, twelveth level number 9 - 1 = 8 and so on.

Level:		
1	8	9
2		8
3		7
4		6
5		5
7		3
8		2
9		1
10		0
11	-1	9
12		8
13		7
.		.
18		2
19		1
20		0
21	-1	9

Step 3: Similarly we apply the operator of the tenth place to the digit at the tenth place. In the present case we subtract 1 (as our operator is -1, therefore we apply -1 at each level) from the tenth place digit to get the corresponding digit as the next level. Here we get 8 - 1 = 7 as the second level digit etc. 1- 1 = 0 is the ninth level digit. Once again we have to carry over unity from the hundredth place to the tenth place. Once again we record -1 in front of the next level i.e., the tenth level in the hundredth place. Therefore we get ten and the tenth level digit at the tenth place is 10 - 1 = 9, the eleventh place digit is 9 - 1 = 8. But we observe that there is already -1 at the eleventh place (due to the carry over to unit place during the previous operation). Therefore the final eleventh level digit at the tenth place is obtained by further subtracting this carry over 1

Level			
1		8	9
2		7	8
3		6	7
4		5	6
5		4	5
6		3	4
7		2	3
8		1	2
9		0	1
10	-1	9	0
11		7	9
12		6	8
.		.	.
.		.	.
17		1	3
18		0	2
19	-1	9	1
20		8	0
21		6	9

from the already obtained digit (8) i.e. 8 - 1 = 7. Further 7 - 1 = 6 is the twelveth level digit etc.

Note: Please try to complete and get the digits atleast upto twenty second level.

Step 4: Further we apply the simple operator (+1 in this case) of the hundredth place to the corresponding digit (which is 0 here). Therefore we get 0 + 1 = 1 the second level digit at the hundredth place, 1 + 1 = 2 the third digit, 2 + 1 = 3 the fourth level digit etc. 7 + 1 = 8 at the ninth level of hundredth place, 8 + 1 = 9 is the tenth level digit. But as we try to enter this at the tenth level we find -1 recorded due to the carry over to the tenth place therefore the final digit at the tenth level shall be 1 less than the digit obtained. Hence 9 - 1 = 8 is the tenth level digit at the hundredth place etc. Please note that similar reduction by 1 shall also be required at the ninteenth level and so on.

Notes:

1. The two examples although have taken rather a lonmg space in explaining the step-by-step process of applying the operators for each digit, but once understood the actual application can be straight away easily mentally performed even by an average student of IV class.

2. Further it is important to note that the operators in any case shall never be more than + 5 and as such the tables upto 5 x 5 would be sufficient.

3. The operators can be conveniently written at the top of corresponding digits and the mentally computed digits at each level are directly written at the appropriate place and column.

Level				
1		0	8	9
2		1	7	8
3		2	6	7
4		3	5	6
5		4	4	5
6		5	3	4
7		6	2	3
8		7	1	2
9		8	0	1
10		8	9	0
11		9	7	9
12	1	0	6	8
				.
				.
17	1	5	1	3
18	1	6	0	2
19	1	6	9	1
20	1	8	6	9
				.
				.

Illustration 5:

Similarly we can easily apply the operators for any other table (once the operators have been identified). Let us take another example of table for the number 22. The operators for this table are +2 and +2 for the unit and tenth place respectively.

Step 1: We divide the number 22 into two parts by drawing a vertical line.

Step 2: We apply the operator to the digit at the unit place to get the digit at the subsequent level. Therefore 2 + 2 = 4 is the second level number, 4 + 2 = 6 is the third level number, 6 + 2 = 8 the fourth level number, 8 + 2 = 10 the fifth level number, we have got the number greater than 9 therefore 1 is carried out tenth place and recorded at fifth level in the tenth column with the positive sign. Further 0 + 2 = 2 gives us the sixth level digit etc.

2	2
	4
	6
	8
+1	0
	2
	4
	6

Step 3: We apply the operator of the tenth place to the corresponding digit. In the present example we get 2 + 2 = 4 as th tenth place digit at second level, 4 + 2 = 6 is the third level digit, 6 + 2 = 8 the fourth level digit, 8 + 2 = 10 the fifth level digit. Once again we find that there is already +1 at the fifth level due to the carry over from the unit place. Therefore the final number at the fifth level is 10 + 1 = 11. Here for subsequent levels one shall be entered uniformly in the hundredth place. Further 1 + 2 = 3 is the sixth level digit and so on.

2	2
4	4
6	6
8	8
11	0
13	2
15	4
17	6
19	8
22	0

2.2.1 The Operators:

We have seen how easily we can operate each digit of the number to write down the table. The entire operation shall require just a few seconds time. The only question left over is how do we identify the operators at the unity, tenth and hundredth place. This is very conveniently done by establishing the set of links between the number and the appropriate base through the suitable sub-base, we frequently invoke the Nikhilam Sutra for this purpose. The required operators in this link chain are the desired operators.

Illustration 6:Let us study the number 19. 19 = 20 - 1 = 2x(10)- 1x(1) is the link chain between the number 19 and the unity 10. Further, we identify that 10 is to be multiplied by +2 and 1 is multiplied by -1. Hence the operators for the tenth and the unit place are +2 and -1 respectively. Once the appropriate operators have been identified the simple mental operations can be performed to get the table in a matter of a few seconds. The detailed step-by-step process has been already explained in the illustrations number 3, 4 and 5.

Ilustration 7: Further the 89 (Ilustration 3) can be linked with the base 1 and 10 as follows-

89 = 90 - 1 = 9x(10)-1x(1)

Therefore, we find the required operators are -1 and +9 for the unit and tenth place. However, as already mentioned, the Vedic Mathematics does not require even the operation with +9. The operators can be further simplified by establishing another link of the tenth place digit (9) with the hundredth place as this number is closer to the base 100.

Alternatively 89 = 90 - 1, 90 = 100 - 10. Therefore 89 = 100 - 10 - 1 = 1x(100)-1x(10)-1x(1) we find that the operators in this link chain are +1, -1 and -1 for the hundredth, tenth and unit place. Hence they are also the corresponding operators for the table 89. Please note that each operator is picked up alongwith its appropriate sign.

After identifying the operators the table can be written down upto any desired level, as already explained in Illustration 4.

Further Illustrations :

(8) 22 = 20 + 2 = 2x(10) + 2x(1)

Therefore +2 and +2 are the operators at the tenth and unit place respectively.

(9) 17 = 10 + 7 = 1x(10)+7x(1)

with operators of 1 and 7. But 7 is too big a number to be permissible in the Vedic System. Therefore preferably and more conveniently we can say that

17 = 20 - 3 = 2x(10) -3x(1) with convenient operators of +2 and -3 at the tenth and unit place respectively.

(10) 28 = 30 - 2 = 3x(10) -2x(1) give the convenient operators of +3 and -2.

(11) 34 = 30 + 4 = 3x(10) + 4x(1)

(12) 85 = 90 - 5 = 9x(10) -5x(1), too big operators

∴ 85 = 90 - 5 = 100 - 10 - 5= 1x(100)-1x(10) -5x(1)

(13) 97 = 100 - 3 = 1x(100) + 0x(10) -3x(1)

with 1, 0, -3 as the three operators.

Discussion:

The same system can be easily extended to even for writing the tables of big numbers. The only difference being a bit larger number of operators. However, the operators establish through the proper links shall never be more than 5. This is because we link the numbers less than 5 to the base or sub-base on the lower side and the bigger numbers are linked with the next base. For example in the previous illiustrations (i) the number 19 is first linked with the nearest sub-base 20 (which is further linked with the base 10 by 20 = 2x10. (ii) the number 89 is linked with the nearest sub-base of 90 (89= 90-1). The number 90 is further linked with the nearest base 100, which is on the higher side. 90 = 100 - 10 and therefore we get 89 = 100 - 10 - 1.(iii) Similarly number 34 is linked with the nearest sub-base 30 which is further linked with the base 10. Therefore 34 = 30 + 4 = 3x(10)+4(1).

Illustration 14 : 123 = 100 + 20+ 3
= 1x(100) +2x(10) +3x(1)

which gives the operators as 1, 2, 3 for the hundredth, tenth and unit place.

Illustration 15: 379 = 380 - 1 = 400 - 20 - 1
= 4x(100) -2x(10) -1x(1)

As a matter of fact the deviation of 79 from the next sub-base can be directly written by using Nikhilam Sutra as -21 etc.

Illustration 16 : 429 =400 + 30 - 1
= 4x((100) + 3x(10)-1x(1)

Illustration 17 : 889 = 1000 - 111
= 1x(1000) -1x(100) -1x(10) -1x(1)

Once again the deviation can be directly written by invoking the Nikhilam Sutra. The only additional point is that the fourth operator for the thousand place has also come into operation.

Illustration 18: 1279 = 1000 + 300 - 20 - 1
= 1x(1000) +3x(100)-2x(10) -1x(1)

Illustration 19 : 1889 = 2000 - 111
= 2000 -100 - 10 - 1
= 2x(1000) -1x(100) -1x(10) -1x(1)

It is interesting to note that the table of a real odd number can be written down at almost magic speed by using the simplest set of operators namely 2,-1, -1 and -1 etc.

Discussions : We find surprising amount of simplicity in the Vedic approach to this facet of tables. It is always desirable to remember some tables but the Vedic method gives the easy and superfast key to any of the tables and thereby the student is not afraid of the tables. As he is confident that in case of any doubt he can write down the table in a few seconds time and thereby relieves him from the fear and pressure generally felt. And with a relaxed mind even the process of remembering tables becomes easy.

Further any table can be down, far far beyond the normal range of the mugged up tables, in a matter of seconds for use in any situation where we are required to multiply several times with the same number.

2. It will be interesting to observe that the operators for the given number will be obtained directly by converting all the digits bigger than 5 to their Vinculum form (Refer Chapter 3).

Further, conversion to Vinculum form can be done by using the Nikhilam sutra. But for small children very simple procedure shall be to add the number to itself, and then subtract the same number from the summation without carrying.

$19 + 19 = 38;\ 38 - 19 = 2\bar{1} (8 - 9 = -1 = \bar{1})$

Similarly $89 + 89 = 178;\ 178 - 89 = 1\bar{1}\bar{1}.$
$(7 - 8 = \bar{1} = 1,\ 8 - 9 = -1 = \bar{1})$

Problems:

1. Write down the tables of following numbers upto 25th level, using Vedic approach:

(i) 8 (ii) 18 (iii) 13 (iv) 32 (v) 102

(vi) 123 (vii) 211 (viii) 92 (hint:91 =1x(100)-1x(10)+2x1))
(ix) 182 (x) 998 (hint: 998 =1x(1000)+0x(100)+0x(10)-2x(1))

2. Find out the operator numbers for the following numbers and then write down the tables upto tenth level:

(i) 88 (ii) 279 (iii) 312 (iv) 1121

(v) 1819

3. Write down the tables of all the illustrations given in the text upto 30th level.

CHAPTER 3

VINCULUM

3.1 INTRODUCTION:

In the previous chapter we have seen how we can use the Nikhilam Sutra and reduce any of the operators for writing tables to be at the most equal to 5. This is a unique facet of Vedic Mathematics. Through this process the computations become far more easier than otherwise. As a matter of fact the unique concept of Vinculum in the Vedic Mathematics is a very interesting useful device.

We are generally not familiar with this approach, therefore before using this Vinculum approach for addition, multiplication, division and squaring etc. It is important to become familiar with it. Through this approach we can make it sure that we have almost never to operate digits larger than 5.

3.2 THE APPROACH

In the Vinculum process we take the complement of the digits bigger than 5 with a negative sign, and a positive carry over to the next higher order digit.

Ilustration 1 : Let us take the number 9. 9 = 10 − 1, therefore 9 is 1 less than 10. This we can also write as $1\bar{1}$, where $\bar{1}$ at the unit place means 1 with a negative sign. For further operations we can use $1\bar{1}$ instead of 9. The property of the numbers is unchanged and we can add, multiply etc. in the usual manner. However, we have to keep in mind that the $\bar{1}$ is always appearing as −1.

In the reverse order, when we need to normalise,

11 = 10 − 1 = 9

Illustration 2: 29 = 30 − 1

This can be written as $3\bar{1}$.

Illustration 3: 37 = 40 − 3 = $4\bar{3}$

So we find that we take the complement of the digit larger than 5 and write this with a bar indicating the negative sign, and increase the digit at the next higher place.

Illustration 4: 79 = 80 − 1 = $8\bar{1}$

Further 80 = 100 − 20 = $1\bar{2}\bar{0}$

Therefore $79 = 8\overline{1} = 1\overline{21}$

So we find 79 can be written as $8\overline{1}$ but since the digit at the tenth place is also very big we can take its complement (from 10, 10 - 8 = 2) and increase the digit previous to this by 1. (0 + 1 = 1, therefore 79 becomes $1\overline{21}$)

It is interesting to note that if there are a few digits larger than 5 appearing together, their collective complement can be directly written by using the Nikhilam Sutra and increasing the previous digit by 1. In this case 9- 7 =2, 10 -9= 1, giving the complement as 21 and the previous digit 0 becomes 0+ 1 = 1. Hence

$79 = 1\overline{21}$.

Illustration 5: 3789

By Nikhilam Sutra, the complements of the last three digits are 9 - 7= 2, 9 - 8 = 1, 10 - 9 = 1, and the previous digit gets increased by 1 (3 + 1 = 4). Therefore,

$3789 = 4\overline{211}$

Illustration 6: 286923

The complement of the larger digits (869) by Nikhilam Sutra is 131. Therefore

$286923 = 3\overline{131}23$

Note: that the last digits 2 and 3 at the tenth and the unit place stay on as before, and the digit previous to the bigger ones gets increased by 1.

Illustration 7: 353782

$353782 = 354\overline{22}2$
(The complement of 78 is $\overline{22}$)

Illustration 8: 3728193

$3728193 = 4\overline{3}3\overline{2}2\overline{1}3$

The application of the Vinculum process should be well practised before we use it.However, its use, makes the computation process quite easy and fast.

Illustration 9: 782893

$782893 = 1\overline{22}3\overline{11}3$

Let us further consider a few exampies of normalizing the Vinculum number. It shall be suprisingly interesting to learn that the

Nikhilam sutra can be used even for the normalizing process. The only difference being that the previous digit is now reduced by 1.

Illustration 10: $3\bar{3}4\bar{4}$

The complement of $\bar{3}$ is 7 and of $\bar{4}$ is 6. Further, each digit before the bar digit gets reduced by 1. So that 3 - 1 = 2 and 4 - 1 = 3.

Therefore $3\bar{3}4\bar{4}$ = 2736

Illustration 11: $3\overline{342}$

Since there are three digits in a group we can use the Nikhilam sutra to straight away write down the complement of this group, and we should remember to reduce the digit previous to this group by 1.

Therefore, by Nikhilam 9- 3 = 6, 9- 4 =5 and 10 - 2 = 8, and 3 - 1 = 2

As such $3\overline{342}$ = 2658

Illustation 12: $2\overline{32}61\overline{12}$

Therefore, $2\overline{32}61\overline{12}$ = 1685892

Illustration 13: $20\overline{34}0\overline{12}1$

$20\overline{34}0\overline{12}1$ = 19659881

Alternatively, we can normalize the above number in two steps

$20\overline{34}0\overline{12}1 = 2\bar{1}66\bar{1}881$

= 19659881

Illustration 14: $3\bar{6}2\overline{27}$

$3\bar{6}2\overline{27}$ = 24173

Note: We may not feel very comfortable to see the numbers bigger than 5 appearing with a bar, i.e. in the Vinculum form, as we would not be generally converting the smaller digits into their Vinculum. However, during the computations of the Vinculum numbers we may frequently end up in a situation like this.

Discussion: We shall operate with the Vinculum numbers exactly in the same manner as we do with the ordinary numbers without Vinculum. In other words, we can understand that the property of these numbers is unchanged. However, we handle them alongwith their minus sign in the usual manner.

Illustration 15: $40\overline{213}1$

Therefore, $40\overline{213}1$ = 397871

In two steps we can say

$$40\overline{213}1 = 417871$$

$$= 397871$$

Further practise shall give us the grip on the system, which is immensely useful for simplifying the computation processes.

3.3 Negative Numbers: A negative number can also be written as a number with a base on all the digits. For convenient operation the bar digits greater than 5 can be converted to +ve digits in the usual manner.

Illustration 16: $-2\ 7\ 4\ 8\ 9 = \bar{2}\ \bar{7}\ \bar{4}\ \bar{8}\ \bar{9}$.

We use Nikhilam sutra to compute the complements of $\bar{7}$ and the pair $\bar{8}\ \bar{9}$. As usual the previous digits have to be decreased by 1, because the bigger bar digits are being converted to the normal +ve form.

$$\bar{2}\ \bar{7}\ \bar{4}\ \bar{8}\ \bar{9} = \bar{3}\ 3\ \bar{5}\ 1\ 1$$

Illustration 17: $-\ 8\ 0\ 3\ 7\ 9 = \bar{8}\ \bar{0}\ \bar{3}\ \bar{7}\ \bar{9}$.

Further, reducing the bigger digits

$$\bar{8}\ \bar{0}\ \bar{3}\ \bar{7}\ \bar{9} = \bar{1}\ 2\ 0\ \bar{4}\ 2\ 1$$

Illustration 18: $-\ 7\ 0\ 8\ 2\ 9 = \bar{7}\ \bar{0}\ \bar{8}\ \bar{2}\ \bar{9}$

$$= \bar{1}\ 3\ \bar{1}\ 2\ \bar{3}\ 1$$

Therefore, it is clear that if the first digit of any number is a bar digit, the number will have a negative value. Further, it shall never be possible to convert all digits of such a numbers into all positive digits.

3.3.1 The magnitude of such a number can be found directly by making all the digits with a bar. As an alternative we can convert all the digits to the +ve digits and an additional digit $\bar{1}$ shall appear on the L.H.S. and the -ve number can then be obtained by writing the complement of all +ve digits using Nikhilam sutra.

Illustration 19: (i) $\bar{3}\ 7\ 8\ \bar{2}\ 1 = -\ 3\ \bar{7}\ \bar{8}\ 2\ \bar{1}$

$$= -\ 2\ 2\ 2\ 1\ 9$$

(ii) OR directly we convert the positive digit to bar digits.

$$\bar{3}\ 7\ 8\ \bar{2}\ 1 = \bar{2}\ \bar{2}\ \bar{2}\ \bar{1}\ \bar{9}$$

as $\bar{3} + 1 = \bar{2}$ and $\bar{2} + 1 = \bar{1}$.

(iii) OR converting bar digits to +ve digits,

$\bar{3}\ 7\ 8\ \bar{2}\ 1 = \bar{1}\ 7\ 7\ 7\ 8\ 1$

Further the complement of all +ve digit shall clearly give the final negative number (−100000 + 77781).

$\bar{1}\ 7\ 7\ 7\ 8\ 1 = 0\ 2\ 2\ 2\ 1\ 9$

Quite clearly the second approach is the easiest and direct.

3.3.2 Decimal Numbers : There is absolutely nothing new and additional information required for handling the decimal numbers and the decimal point shall continue to remain at the same location.

Illustration 20: $1\ 2\ 0.9\ 8\ 1 = 1\ 2\ 1.\ \bar{1}\ \bar{2}\ 1$

Illustration 21: $0.\bar{3}\ 7\ 2\ \bar{8} = 0.\ 3\ \bar{7}\ \bar{2}\ 8 = -\ 0.2\ 2\ 8\ 8$

OR $0.\bar{3}\ 7\ 2\ \bar{8} = \bar{1}.\ 7\ 7\ 1\ 2 = -\ .2\ 2\ 8\ 8$

OR directly $.\bar{3}\ 7\ 2\ \bar{8} = 0.\ \bar{2}\ \bar{2}\ \bar{8}\ \bar{8} = -\ 0.2\ 2\ 8\ 8$

PROBLEMS:

Q.1 Write the following numbers in Vinculum form:

(i) 298 (ii) 63 (iii) 971 (iv) 1618 (v) 298705

(vi) 191816 (vii) 48990291 (viii) 90836281

(ix) 99910892 (x) 90912546832 (xi) 9234671

(Hint: Use of Nikhilam Sutra will help you)

Q.2 Write down the Normalised form of following Vinculum numbers:

(i) $2\ \bar{7}\ 1$ (ii) $\bar{7}\ \bar{1}\ \bar{2}\ 8$ (iii) $3\ \bar{5}\ \bar{1}\ \bar{8}$ (iv) $1\ \bar{2}\ \bar{3}\ 1\ \bar{1}\ 1\ 1$

(v) $2\ \bar{7}\ \bar{2}\ \bar{1}\ 6\ \bar{5}\ 3$ (vi) $3\ \bar{8}\ \bar{9}\ \bar{6}\ 0\ \bar{1}\ \bar{3}\ 4$ (vii) $5\ 1\ \bar{9}\ \bar{2}\ 3\ \bar{3}\ \bar{2}\ 1$

(viii) $5\ \bar{1}\ \bar{2}\ 0\ \bar{1}\ \bar{2}\ 0\ 6$ (ix) $5\ \bar{4}\ 0\ \bar{3}\ 2\ \bar{2}\ 1\ \bar{1}\ 0$

(x) $5\ \bar{1}\ 7\ \bar{2}\ 3\ \bar{3}\ 5\ \bar{4}\ 3$ (xi) $5\ 0\ 0\ \bar{3}\ \bar{4}\ 2\ 0\ \bar{7}$

Q.3 (a) What is your opinion and impression about this new Vinculum approach?

(b) Do you know that this is used in computer ? How this has straight gone to computers?

CHAPTER 4

ADDITION

4.1 INTRODUCTION:

The process of addition in Vedic method is converted to a series of very simple additions, each number being always less than 10. The simple sutra Shudha' is deployed whenever the addition exceeds 9. The step-by-step process is illustrated in the following examples:

4.2 EXAMPLE 1 :

$$\begin{array}{rl} 379 & \\ 854 & \\ 767 & \uparrow \\ 426 & \\ \hline \\ \hline \end{array}$$

Step 1: The addition is carried out column by column in the usual manner, moving from bottom to top.

(a) 6 + 7 gives 13 which is more than 9 so Shudha is said and a dot is put above 7. The tenth place, unity is dropped and only the number of the unit place (3) is carried forward. The unit place number (3) is added to the next number.

(b) 3 +4 = 7 therefore, no Shudhikaran is required at this stage. By adding the next number to the result we get 7 + 9=16. Once again `Shudhikaran'is required. We say Shudha and put a dot above the latest digit (9). The unity at tenth place is dropped and the number at unit place is the answer.

$$\begin{array}{r} 37\dot{9} \\ 854 \\ 76\dot{7} \\ 426 \\ \hline 6 \\ \hline \end{array}$$

(c) The addition process in the upward direction has been used. However, the addition can be carried on in the downward direction with equal ease and accuracy.

Step 2: Before moving to the second column (10th place) the dots due to Shudhikaran in the first column (unit place) are counted (2 in this case). This is added to the lowest number 2 + 2 = 4. The result is added to the next number 4 + 6 =10. Therefore, we say Shudha, put a dot above the latest digit (6). The unity at tenth place is dropped and the number at the unit place is carried forward (0).

0 + 5 = 5 is the result of addition of the next digit, which is added to the next number (7 which is also the last number in this column). Therefore 5 + 7 = 12. Once again 'Shudhikaran' is carried out. We get a dot above the last number (7) and the left over digit at the unit place is the answer (2).

```
 ..
379

854
 ..
767

426  ↑
-------
 26
-------
```

Step 3: Before moving on to the hundredth place (the third column), the dots due to 'Shudhikaran' process in the second column are counted (which are 2 in this case).

(a) This is added to the lowest number 2 + 4 = 6, the resulting number is added to the next number 6 + 7 = 13, since the resulting number has exceeded 10, 'Shudhikaran' is required. Therefore we say Shudha and put dot above the latest number (7), drop the tenth place unity and carry forward, the left over digit at the unit place (3).

(b) This is added to the next number 3 + 8 = 11. Therefore the latest number (8) also gets a dot of 'Shudhikaran' and the left over number at the unit place (1) is carried forward. This when added to the subsequent number yields the answer 1 + 3 = 4.

(c) The number of dots due to 'Shudhikaran' are counted to get the carry over number at the thousandth place (2).

```
  ..
  379
  .
  854
  ...
  767
  426
--------
 2426
--------   Hence 2426 is the answer.
```

4.3 EXAMPLE 2:

```
   78924
     .
   27272
      .
   99999
     .
 + 72672
----------
      67
----------
```

Step 1: Addition is done in the downward direction.

Step 2: 4 + 2 =6, 6 + 9 = 15 (Shudha), 2 + 5 = 7. Put 7 as the answer of the first column.

Step 3: 1 + 2 = 3, as the Shudhikaran is done only one time 3 + 7 =10 Shudha, 0 + 9= 9, 9+ 7= 16 (Shudha).

Step 4: 9+ 2 =11 (Shudha), 1 + 2 = 3, 3 + 9=12 (Shudha), 2 + 6= 8.

Step 5: 8 + 2 =10 (Shudha),0 + 7= 7, 7 + 9 = 16 (Shudha), 6 + 2= 8.

Step 6: 2 + 7 = 9, 9 + 2 = 11 (Shudha), 1 +9 =10 (Shudha), 0 + 7= 7.

Step 7: In case of the last column Shudhikaran is done 2 times, so we will write 2 in front of the last digit that is 7.

```
 ..
78924    ↓
.  .
27272
... .
99999
   .
72672
---------
278867 Ans.
---------
```

4.4 EXAMPLE 3:

```
    29796
               ↓
        .
    65728
        .
    23999
+   54321
---------
---------
```

Step 1: 6 + 8 = 14, 4 + 9 = 13, 3 + 1 = (4) (two dots)

Step 2: 9 + 2 = 11, 1 + 2 = 3, 3 +9 =12, 2 + 2 = (4) (two dots)

Step 3: 2 + 7 = 9, 7 + 9 = 16, 6 + 9 = 15, 5 + 3 =(8) (two dots)

Step 4: 9 + 2 = 11, 1 + 5 = 6, 6 + 3 = 9, 9 + 4 = 13,(3) (two dots)

Step 5: 2 + 2 = 4, 6 + 4 = 10, 0 + 2 = 2, 5 + 2 = 7 (one dot)

```
      . .
     29796
     . . .
     65728
       ...
     23999
     .
+    54321
-----------
    173844   Ans.
```

4.5 DISCUSSIONS:

1-- Even the simplest process of mathematics-additon, is further simplified in Vedic Mathematics system.

2. It is easier and faster to add only 1 digit numbers.

3. The chances of errors are also reduced, and there is a checking system also available (Chapter 6).

PROBLEMS:

Q.1 Add the following numbers. Use Vedic Shudhikaran operation whereever necessary :

```
   9878       98989        989898      9898989
   3113       93189        110079      7658972
 + 8009     +  4039      + 897597    + 9753468
   ----       -----        ------      -------

         98989898             98989898
         10756891             60895007
       + 94372615           + 32783914
         --------             --------
```

Q.2 Check up whether Vedic Shudhikaran operation is done correctly (shown through dots) and then do the addition (Arrow indicates direction of travel for addition).

```
  77        89        998          9897
                       .
  68        89        102          9469
   .         :         .            ...
+ 57      + 98      + 983        + 8358
  ---       -----                  .  .
                    + 269        + 7456
                      ---          ....
                                 + 6589
                                   ----
```

Q.3 Which of the following additions require Shudhikaran operation? Do the addition.

```
  98       9898      989      639
  86       9037      329       87
  37        638      761      308
  --       7008      104       61
           9833       67     ----
           -----     ---
```

Q.4 Check up whether the following additions are correct.

```
83        309       893       341
..         .          .         .
29        447        38      8369
---       . .                  .
112       629        47        97
          ----      . .       ...
          1375      518       739
                    ----      ----
                    1486      9536
```

Q.5 Encircle the digits where the dots of Shudhikaran are incorrectly placed and also complete the addition.

```
37209       25786        34098
. .                        . .
08477         723         6179
------                     . .
              ...
            97363         3681
            -------      94302
                        -------
```

Q.6 Solve above questions using the Vinculum approach ofVedic Mathematics.

Q.7 Comment on efficiency of this Vedic Method of addition.

CHAPTER 5

SUBTRACTION

5.1 INTRODUCTION

The process of subtraction in Vedic method is converted to a series of simple additions and subtraction. The sutra Shudha is deployed whenever the larger digit is to be subtracted from the smaller digit. The step-by-step process is illustrated in the following examples :

5.2 EXAMPLE 1 :

```
  5 7
- 3 2
---------
---------
```

Step 1: The digit 2 at unit place is smaller than 7.

Therefore, 7- 2 = 5 (No Shudhikaran is required)

Step 2: The digit 3 at tenth place is smaller than 5.

```
 57
-32
-----
 25
-----
```

Therefore, 5 - 3 = 2(no Shudhikaran is required).

5.3 EXAMPLE 2:

```
4 2
.
2 7
----------
----------
```

Step 1: The digit 7 at the unit place is larger than digit 2.

Therefore, Shudhikaran is required.

(a) Put a dot above the next digit (that is 2 in this case)

(b) Subtract 7 from base 10 to compute how much less it is than the base 10- 7 = 3.

(c) Add this difference to the corresponding number (which is 2 here).

Therefore, 3 + 2 = 5.

(d) Put the result as the answer digit at the unit place.

```
4 2
.
2 7
------
   5
```

Step 2:

(a) Move to tenth place.

(b) Since the digit has a dot above it, increase it by 1.
(c) We get 2 + 1 = 3 at the tenth place.

(d) Compare. It is smaller than the corresponding number 4 (Therefore no Shudhikaran).

(e) Compute the difference 4 - 3 = 1 to get the answer digit at the tenth place.

$$\begin{array}{r} 4\ 2 \\ -\ \dot{2}\ 7 \\ \hline 1\ 5 \\ \hline \end{array}$$

5.4 EXAMPLE 3:

$$\begin{array}{r} 4\ 1\ 5 \\ -\ 2\ \dot{0}\ 8 \\ \hline \\ \hline \end{array}$$

Step 1: The digit 8 is larger than 5. Therefore Shudhikaran is required.

(a) Put a dot above the next digit (0 here).

(b) Subtract from base 10, to compute how much it is below the base. We get 2. 10 - 8 = 2

(c) Add the resultant digit to the corresponding number at unit place (which is 5 here). Therefore, 5 + 2 = 7

(d) Put the result as the answer digit at the unit place.

$$\begin{array}{r} 4\ 1\ 5 \\ -2\ \dot{0}\ 8 \\ \hline 7 \\ \hline \end{array}$$

Step 2:

(a) Move to the tenth place.

(b) Since the digit has a dot above it. Increase by it 1.

(c) We get 0 + 1 = 1.

(d) Compare. It is equal to the corresponding number, 1 in this case.

(e) Therefore we get 1 - 1 = 0.

$$\begin{array}{r} 4\ 1\ 5 \\ -\ 2\ \dot{0}\ 8 \\ \hline 0\ 7 \\ \hline \end{array}$$

Step 3: The digit 2 at the hundredth place is less than the corresponding number 4. Therefore 4 - 2 = 2 is the answer digit at hundredth place.

$$\begin{array}{r} 4\ 1\ 5 \\ -\ 2\ \dot{0}\ 8 \\ \hline 2\ 0\ 7 \\ \hline \end{array}$$

5.5 EXAMPLE 4:

$$\begin{array}{r} 3\ 7\ 5\ 2 \\ -\ 1\ 8\ 7\ 1 \\ \hline \\ \hline \end{array}$$

Step 1: The unit 1 is smaller than 2, therefore 2 - 1 gives 1 at the unit place (no Shudhikaran is required)

Step 2: The digit at the tenth place is 7 and greater than the corresponding digit 5. Therefore we do Shudhikaran and put a dot above the next digit. Compute the difference of the larger number from the base 10 which is 3 in this case. Add this difference to the digit at the top to get the digit at this place. Therefore 3 + 5 = 8.

$$\begin{array}{r} 3\,7\,5\,2 \\ -\,\dot{1}\,\dot{8}\,7\,1 \\ \hline 8\,1 \\ \hline \end{array}$$

Step 3: Since there is a dot above the next digit i.e. above 8. Therefore, this digit is increased by 1 which, in this case becomes 9. Now 9 is greater than 7 (at the hundredth place). Therefore Shudhikaran is done and put a dot above 1. Compute the difference of the larger number from the base 10 which is 10 - 9 = 1 in this case. Add this difference to the digit at the top. Therefore, 1 + 7 = 8.

$$\begin{array}{r} 3\,7\,5\,2 \\ -\,\dot{1}\,\dot{8}\,7\,1 \\ \hline 8\,8\,1 \\ \hline \end{array}$$

Step 4: Since there is a dot above the next digit i.e. above 1. Therefore, this digit is increased by 1, which in this case becomes 2. Now 2 is smaller than 3 and Shudhikaran is not required. The difference of 3 - 2 =1 gives the digit at this place.

$$\begin{array}{r} 3\,7\,5\,2 \\ -\,\dot{1}\,\dot{8}\,7\,1 \\ \hline 1\,8\,8\,1 \\ \hline \end{array}$$

Discussions:

1. In Vedic method even the simple operation of subtraction is easier than the normal method. Here no carry over is required.

2. Computing the complement of the digit, for which the Shudhikaran is being done, is far more easier and subsequent addition is also faster.

3. The Vedic method of compound subtraction shall be presented in Pushp-II.

PROBLEMS:

Q.1 Solve the following questions. Use the Vedic Shudhikaran Process :

1. $\begin{array}{r} 36 \\ -28 \\ \hline \end{array}$ 2. $\begin{array}{r} 324 \\ -115 \\ \hline \end{array}$ 3. $\begin{array}{r} 437 \\ -269 \\ \hline \end{array}$ 4. $\begin{array}{r} 506 \\ -107 \\ \hline \end{array}$ 5. $\begin{array}{r} 728 \\ -\ 89 \\ \hline \end{array}$ 6. $\begin{array}{r} 8472 \\ -3796 \\ \hline \end{array}$

7. $\begin{array}{r} 49062 \\ -\ 8648 \\ \hline \end{array}$ 8. $\begin{array}{r} 87211 \\ -\ 3088 \\ \hline \end{array}$ 9. $\begin{array}{r} 98356 \\ -\ 79467 \\ \hline \end{array}$ 10. $\begin{array}{r} 864237 \\ -\ 270038 \\ \hline \end{array}$

11. $\begin{array}{r} 680032 \\ -\ 68810 \\ \hline \end{array}$ 12. $\begin{array}{r} 10000000 \\ -\ 8764321 \\ \hline \end{array}$ 13. $\begin{array}{r} 6011123 \\ -5020034 \\ \hline \end{array}$ 14. $\begin{array}{r} 100000000 \\ -\ 99999999 \\ \hline \end{array}$

Q.2 Check whether the dots due to the Vedic Shudhikaran shown are correct or not and solve the question:

$$\begin{array}{r} 25 \\ -\dot{2}2 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 86 \\ -\dot{3}4 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 78 \\ -\dot{6}9 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 32 \\ -\dot{2}1 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 33 \\ -2\dot{3} \\ \hline \\ \hline \end{array}$$

Q.3 Which of the following questions need Shudhikaran?

$$\begin{array}{r} 36 \\ -24 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 24 \\ -16 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 20 \\ -11 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 38 \\ -20 \\ \hline \\ \hline \end{array} \quad \begin{array}{r} 93 \\ -33 \\ \hline \\ \hline \end{array}$$

Q.4 Check the solutions given in the following questions.

$$\begin{array}{r} 36 \\ -\dot{2}4 \\ \hline 12 \\ \hline \end{array} \quad \begin{array}{r} 33 \\ -\dot{2}4 \\ \hline 09 \\ \hline \end{array} \quad \begin{array}{r} 30 \\ -\dot{2}7 \\ \hline 03 \\ \hline \end{array} \quad \begin{array}{r} 28 \\ -\dot{1}9 \\ \hline 19 \\ \hline \end{array} \quad \begin{array}{r} 38 \\ -\dot{2}9 \\ \hline 09 \\ \hline \end{array}$$

Q.5 Encirlce the digits where the dots of Shudhikaran are incorrectly placed, and complete the problem.

(a) $\begin{array}{r} 37209 \\ \dot{1}9\dot{1}\dot{1}7 \\ \hline \\ \hline \end{array}$ (b) $\begin{array}{r} 27569 \\ \dot{0}\dot{8}4\dot{7}\dot{7} \\ \hline \\ \hline \end{array}$ (c) $\begin{array}{r} 78952 \\ 2\dot{9}\dot{7}\dot{7}8 \\ \hline \\ \hline \end{array}$

CHAPTER 6

VEDIC CHECK FOR ADDITION AND SUBTRACTION

6.1 INTRODUCTION

In the last two chapters we have seen that even the simple operations of addition and subtraction can be done faster by using the simple Vedic sutra Shudha.One of the unique facets of the Vedic methods is the simple methods for checking the correctness of all the arithmetical operations, like addition, subtraction, multiplication and division etc. It is further interesting to note that these methods can also be extended and applied with equal ease, efficiency and accuracy even to the algebraic operations including factorization, partial fractions etc. However, at present we shall just see the step by step methods of checking the correctness of any addition or subtraction.

6.2 SUBTRACTION - CHECK

In the fifth chapter we have learnt the Vedic method of subtraction by using the sutra Shudha. We have seen that in the Vedic method there is absolutely no need to carry the digit to the lower place, as is required in the present system.The concept of carrying the digit to the lower place, we know is very difficult to learn for the small children.

The simple operations involved in checking the correctness of the subtraction are that we convert each of the three numbers, namely, the number, the number to be subtracted and the result, into single digit numbers. This is accomplished by adding digit by digit, the different digits of the number.As soon as this addition gives us a two digit number, we add the two digits together to convert them into a single digit number. Further we add the equivalent single digit number of the result to the single digit number obtained by adding the number subtracted. Once again if this addition gives a two digit number, we add the two digits together to finally get the single digit additon. The single digit number thus obtained should be equal to the equivalent single digit number obtained from the original number.

The step by step procedure is outlined in the following examples.

6.2.1 Example

Say we subtract 32 from 57.We draw a in front of the sum and divide into four squares by joining the mid-points :

```
  5 7        II _____ I
- 3 2          |  |  |
  ---          |--|--|
  2 5       III|__|__|IV
  ---
```

Step 1: The result 25 converted to a single-digit number gives 2 + 5 = 7. This is written in the lower right square (IV).

Step 2: The number subtracted 32 similarly gives the single-digit number as 3 + 2 = 5 and is written in the lower left square (III).

Step 3: Similarly, `the original number 57 gives the single-digit number as 5 + 7 =12, 1 + 2 = 3.

Since addition of 5 + 7 has given a two-digit result 12, we add the digits once again to finally end in the single -digit number. This is written in the upper left square (II).

```
 ________        5 + 7 =12,
| 3  |   |
|____|___|       1 + 2 = 3
| 5  | 7 |
|____|___|
```

Step 4: Now we add the equivalent single-digit number of the answer (step 1) to the single-digit number of the number subtraction (step 2). In the present example 5 + 7 = 12, 1 + 2 = 3 therefore giving 3 as the final single-digit number. The single digit thus obtained is entered in square I. Since this is equal to the single-digit number obtained for the original number (step 3) written in square II. We can be reasonably sure that our subtraction is correct.

```
 ________
| 3  | 3 |
|____|___|
| 5  | 7 |
|____|___|
```

Discussion:

We find the step-by-step process of checking the correctness of subtraction to be quite simple, easy and straight forward. However, it shall be useful to study a few more examples so as to become quite familiar with this rather easy method.

6.3 FURTHER ILLUSTRATIONS

Illustration 1: Let us take the subtraction of 1871 from 3752. Using the sutra Shudha we can perform this subtraction without any formal carryover, in the usual sense of the term. We draw a square in front of this computation and divide it into four squares. Please note that we number the squares in the same order as for the co-ordinate geometry, I, II, III and IV in the anticlockwise direction

```
  3 7 5 2            ______
  . .            II|   |   |I
- 1 8 7 1          |---|---|
___________     III|___|___|IV
  1 8 8 1
___________
```

Step 1: The result (1881) when converted to the single-digit number gives 1 + 8 = 8; 9 + 8 =17; 1 + 7= 8; 8 + 1 = 9 which we write down in the lower right square IV. Once again we observe that as soon as the summation of the digits yields a two-digit result (9+ 8 = 17, we add the two digits of the result to get a single-digit which is subsequently used for adding to the remaining digits of the number.

Step 2: Similarly, the number subtracted (1871) gives the single-digit number as 1 + 8 = 9,9 + 7= 16;1 + 6 = 7; 7 + 1 = 8. The resulting single digit number is written in the lower left square III

```
  II _______I
    | 8 |   |
    |___|___|
    | 8 | 9 |
 III|___|___|IV
```

Step 3: The single digit equivalent number for the original number (3752) is obtained as 3 + 7 = 10; 1 + 0 = 1; 1 + 5 = 6; 6 + 2 = 8. This is written in the upper left square II.

Step 4: Finally we add the equivalent single-digit number of the answer obtained in step 1(square IV) to the single-digit number of the number subtracted obtained in step 2 (square III).

In the present example 9 + 8 = 17, 1 + 7 = 8. This is entered in square I. We compare the numbers in squares I and II.Since they are both equal we can be reasonably be sure that the subtraction is correct.

```
   II_________I
    | 8  | 8 |
    |____|___|
    | 8  | 9 |
 III|____|___|IV
```

Illustration II:

```
 1 0 0 0 0 0 0 0
   . . . . . .
 - 8 7 6 4 3 2 1
------------------
   1 2 3 5 6 7 9
------------------
```

```
   II ________ I
    |    |    |
    |____|____|
 III|____|____|IV
```

We draw the square as usual.

Step 1: The single-digit number is obtained as 1 + 2 = 3; 3 + 3 = 6; 6 + 5 = 11,1 + 1 = 2; 2 + 6 = 8; 8 + 7= 15, 1 + 5 = 6; 6 + 9 = 15, 1 + 5 = 6 and entered in square IV.

Step 2: Similarly, the single digit equivalent of the number subtracted is 8 + 7 = 15, 1 + 5 = 6; 6 + 6 = 12, 1 + 2 = 3; 3 +4 = 7; 7 + 3 = 10, 1 + 0 = 1; 1 + 2 = 3; 3 + 1 = 4.This is entered in lower left square III.

```
   II ________ I
    |    |    |
    |____|____|
    |    |    |
 III|____|____|IV
```

Step 3: The single digit number for the original number is obtained as 1 + 0= 1; 1 + 0 = 1 etc. = 1 and entered in upper left square II.

Step 4: We add the digits in III and IV to obtain the single check digit for square I.

Therefore, we get 6 + 4=10; 1 +0 = 1.Once again we find that the single digits obtained in square I and II are the same. Hence the check is satisfied.

Notes:

1. With a little practice, the whole process can be done mentally in just a few seconds time.

2. It is interesting to observe that the addition of nine while converting to the single digit equivalent number makes no effect on the digit being added. Therefore, we may easily skip the nine digits in the number, further reducing the effort.

ADDITION-CHECK:

After learning the unique and yet simple, easy and superfast Vedic method for checking the correctness of subtraction, we can see how the same approach can be extended for checking the correctness of even long additions. The sutra employed for these checks is having a large number of applications and shall be introduced abit later. However, we can learn the simple step by step method of checking the correctness of the addition.

The Method: In the Vedic method we convert each of the numbers to its equivalent single-digit number. Further, the addition of these single-digit numbers converted to a single-digit form shall be equal to the single digit equivalent of the result of addition.

The step by step method is outlined with the help of the following examples.

Example III: Let us say we have added two numbers 26789 and 35274.

```
    2 6 7 8 9
  + 3 5 2 7 4
  -----------
    6 2 0 6 3
  -----------
```

Step 1:

We add the digits of the first number to obtain the equivalent single-digit number. Here 2 + 6 = 8; 8 + 7 =15, 1 + 5 = 6; 6 + 8 =14, 1 + 4 = 5; 5 + 9 = 14,1 + 4 = 5. The single digit number thus obtained is written in front of the first number.

Step 2:

Further we obtain the single digit equivalent number for the second number. In the present example 3 + 5 = 8; 8 + 2 = 10,1 + 0 = 1; 1 + 7 = 8; 8 + 4 = 12, 1 + 2 = 3. Once again this is written in front of the second number.

Step 3:

Similarly we obtain the single digit number for the addition and write it down in front of the answer. Here 6 + 2 = 8; 8 + 0 = 8; 8 + 6 = 14, 1 + 4 = 5; 5 + 3 = 8.

Step 4:

Finally we add the single-digit numbers obtained in step 1 and 2. The resulting digit should be equal to the single digit obtained in the previous step. If it is so, it confirms the correctness of the addition. In the present example 5 + 3 =8 which is the same as obtained in step 3.

$$\begin{array}{rrcl} & 2\,6\,7\,8\,9\,5 & & 5 \\ + & 3\,5\,2\,7\,4\,3 & & 3 \\ \hline & 6\,2\,0\,6\,3\,8 & = & 8 \quad \text{Okay} \end{array}$$

Further Illustration IV:

$$\begin{array}{rr} & 3\,7\,9 \\ & 8\,5\,4 \\ & 7\,6\,7 \\ + & 4\,2\,6 \\ \hline & 2\,4\,2\,6 \end{array}$$

Step 1:

For addition we can use the sinple Vedic sutra Shudha and write down the result of addition much faster than the ordinary method, as in the Vedic method the addition at every step consists of only single-digit numbers. Further the chances of error are minimised. However, it is useful to check the arithmetic addition. We add the digits of the first number to convert them into a single-digit number, Here 3 + 7 = 10, 1 + 0 = 1; 1 + 9 = 10, 1 + 0 = 1, 1 is the single digit equivalent of the first number. This single-digit number is written in front of the first number.

Step 2:

Similarly, the single-digit equivalent of the second number is obtained, and written in front of the second number. Here 8 + 5 = 13, 1+ 3 =4; 4 +4 =8, 8 is the desired number.

Step 3:

.The process is repeated for all the numbers. Here 7 + 6 = 13, 1 +3 = 4; 4 + 7 =11, 1 + 1 = 2 is the single digit equivalent of the third number. Further the fourth digit number is obtained as 4 + 2 = 6; 6 + 6 =12, 1 +2 =3;

$$\begin{array}{rcl} 3\,7\,9 & & 1 \\ 8\,5\,4 & & 8 \\ 6\,6\,7 & & 2 \\ 4\,2\,6 & & 3 \\ \hline 2\,4\,2\,6/5 & = & 5 \quad \text{Okay} \end{array}$$

Step 4:

Now we add the digits of the addition to get the equivalent single digit which is written in front of the answer. In the present example 2 + 4 = 6; 6 + 2 = 8; 8 + 6 = 14, 1 + 4 = 5.

Step 5:

Finally we add the single digit numbers to get the equivalent number. If our addition is correctthis must be the same as the single digit equivalent number of the answer obtained in the previous step. Here 1 + 8 = 9; 9 + 2 = 11, 1 + 1 = 2; 2 + 3 = 5. Since 5 is the same as previously obtained hence the correctness of the answer is confirmed.

DISCUSSION:

1. In the normal method, the only way of checking the correctness of the addition is to repeat the process. This takes the same amount of time and effort.

2. The Vedic method of checking the addition by converting to an equivalent single digit is decidedly faster.

3. Further it provides an independent check.

4. It is interesting to mention that the Vedic method of checking the addition, though faster and easier than the present method, is still too long when compared to the rather superfast methods of checking the correctness of the multiplication, division, both arithmetic and algebraic, factorisation, partial fractions etc., to be learnt in the subsequent chapters and subsequent volumes.

5. Finally we may be really thrilled to note that essentially only one Vedic sutra is at work in all these different checks. The detailed discussion and meaning of the same shall be taken up in Pushp-III.

PROBLEMS:

Q.1 Perform the following subtraction and check by Vedic method :

(i) $\begin{array}{r} 1\,5\,8\,6 \\ -0\,9\,6\,7 \\ \hline \end{array}$ (ii) $\begin{array}{r} 1\,1\,1\,1\,1 \\ -\ 8\,6\,9\,9 \\ \hline \end{array}$ (iii) $\begin{array}{r} 1\,0\,9\,2\,3\,4 \\ -\ 9\,2\,3\,4\,1 \\ \hline \end{array}$

(iv) $\begin{array}{r} 7\,2\,5\,6\,7\,8\,9 \\ -\,2\,9\,6\,7\,9\,8\,2 \\ \hline \end{array}$

Q.2 Are the following additions correct? Check by Vedic method.

(i)
$$\begin{array}{r} 5896 \\ 2587 \\ 6258 \\ \hline 18643 \\ \hline \end{array}$$

(ii)
$$\begin{array}{r} 125678 \\ 923456 \\ 908754 \\ 030567 \\ \hline 1887645 \\ \hline \end{array}$$

(iii)
$$\begin{array}{r} 5456 \\ 9234 \\ 9367 \\ 9516 \\ 8675 \\ \hline 42268 \\ \hline \end{array}$$

(iv)
$$\begin{array}{r} 99998569 \\ 82016786 \\ 78568675 \\ 98056123 \\ \hline 358640153 \\ \hline \end{array}$$

Q.3 Check by Vedic method the additions performed in Problems of Chapter 4 on Addition.

Q.4 Check by Vedic method the subtractions performed in Problems of Chapter 5 on Subtraction.

CHAPTER 7

MULTIPLICATION

7.1 INTRODUCTION

It is interesting to note that there is a general formula which can be applied to all cases of multiplication. This formula is quite easy and simple. However, there are special cases where special Vedic procedure gives much simpler, easier and quicker solutions. The later shall be discussed first.

7.2 NIKHILAM SUTRA

It reads Nikhilam Navatascaramam Dasatah. The literal translation of this crisp Sutra is

"All from 9 and the last from 10"

The multiplication procedure based on this Sutra is known as the Nikhilam method. This is very convenient method for multiplying numbers which are close to the base (Refer chapter 1). The exact use of this Sutra shall be elaborated in later sections.

Now the step by step procedure is outlined in the following sections.

7.3 TYPE - 1

7.3.1 Let us take the simple example of multiplying 13 by 11.

Step 1: We write these numbers in the Vedic base system style and get: (Refer chapter 1).

```
13 + 3
11 + 1
------
```

We note that the base is 10 and there is only zero 1 in the base. Positive sign indicates that both numbers are greater than the base.

Step 2: The product will have two parts. An inclined dividing line should be drawn to demarcate these two parts.

```
13 + 3
11 + 1
------
  /
------
```

Step 3 We vertically multiply the excess digits from base. This product gives us right hand portion of the answer. In this case 3 x 1 =3 is the product.

```
13 + 3
11 + 1
------
     3
------
```

Step 4: (a) The left hand side of the answer can be arrived at by simply adding diagonally any of the two given numbers with the deviation (deficit) of the other number from base.

Case 1: The first number 13 is added to 1, the deficit of second number. Therefore 13 + 1 = 14

Case 2: The second number 11 is added to 3 the deficit of the first number. Therefore 11 + 3 = 14

NOTE: Both of these alternatives gives the same result.

Step 4: (b) In addition to the above two alternatives the left hand side can also be obtained by following two additional procedures.

$$\begin{array}{r} 13 + 3 \\ 11 + 1 \\ \hline 14/\ \ 3 \\ \hline \end{array}$$

Case 1: Subtract the base from the sum of the given numbers. Here the base is 10 and the sum of the given numbers is 13 + 11 = 24. Therefore, sum-base = 24 - 10 = 14.

Case 2: Add the sum of the two deficits to the base. Here the sum of the two deficits is 3 + 1 = +4. Therefore, base +sum = 10+ 4 =14.

Both of these alternatives also give the same correct L.H.S. of the answer.

Step 5: Thus 11 x 13 = 143.

$$\begin{array}{r} 13 + 3 \\ 11 + 1 \\ \hline 14\ /\ 3 \\ \hline \end{array}$$

NOTE: The Vedic System has this special feature of availability of the same result in several easy ways. This feature can be utilised by the student to verify his answer step-by-step.

7.3.2 Further Illustrations

$$\begin{array}{cccccc} 14 + 4 & 11 + 1 & 19 + 9 & 12 + 2 & 17 + 7 & 13 + 3 \\ 12 + 2 & 15 + 5 & 11 + 1 & 13 + 3 & 11 + 1 & 13 + 3 \\ \hline 16\ /\ 8 & 16\ /\ 5 & 20\ /\ 9 & 15\ /\ 6 & 18\ /\ 7 & 16\ /\ 9 \\ \hline \end{array}$$

An important point to be observed is that in each of these cases the multiplication of the deficit digits yields a single digit. Since the bases in all of them is 10, it has only one zero and as such the single digit answer on the right hand side creates no problem.

7.4 TYPE - 2

In case of the multiplication problems where the deficit multiplication yields digits more than the number of zeros in the base, the excess digits are carried over to the left hand side and added to left hand answer obtained in the above mentioned way (Step4).

7.4.1 Illustrations

(i) 14 x 13

$$\begin{array}{l} 14 + 4 \\ 13 + 3 \\ \hline 17 \ / \ 2 \quad = 17 + 1/2 = 18/2 = 182 \\ 1 \\ \hline \end{array}$$

(ii) 16 x 12

$$\begin{array}{l} 16 + 6 \\ 12 + 2 \\ \hline 18 \ / \ 2 \quad = 18 + 1/2 = 19/2 = 192 \\ 1 \\ \hline \end{array}$$

(iii) 18 x 13

$$\begin{array}{l} 18 + 8 \\ 13 + 3 \\ \hline 21 \ / \ 4 = 21 + 2/4 = 23/4 = 234 \\ 2 \\ \hline \end{array}$$

Let us take some illustrations with higher bases

(iv) 106 x 105

$$\begin{array}{l} 106 + 6 \\ 105 + 5 \\ \hline 111 \ /30 \\ \hline \end{array}$$

In this illustration the product of the deficit numbers is 6 x 5 = 30. And it has only two digits which are equal to number of zeros in the base (base is 100). Therefore, two digits are permissible on the R.H.S. and no carry over is required.

(v)

$$\begin{array}{lll} 109 + 9 & 108 + 8 & 102 + 2 \\ 111 + 11 & 109 + 9 & 144 + 44 \\ \hline 120 \ / \ 99 & 117 \ /72 & 146 \ / \ 88 \\ \hline \end{array}$$

(vi) 111 x 112

$$\begin{array}{l} 111 + 11 \\ 112 + 12 \\ \hline 123 \ / \ 32 = 123 + 1/32 = 124/32 = 12432 \\ 1 \\ \hline \end{array}$$

NOTE: The R.H.S. should be obtained by mentally performing the Vedic method i.e.

$$\begin{array}{l} 11 + 1 \\ 12 + 2 \\ \hline 13 \ / \ 2 \\ \hline \end{array}$$

```
(vii)113 x 114                                     Solving R.H.S.

     113 + 13                                          13 + 3
     114 + 14                                          14 + 4
    ------------                                    ------------
     127 / 82 =127 +1/82 =128/82                       18 / 2
           1                                        ------------
    ------------             = 12882

    (viii) 117 x 118                                   Solving R.H.S.

       117 + 17                                        17 + 7
       118 + 18                                        18 + 8
      ------------                                   ----------
       135 / 06  = 135 + 3/06 = 13806                  30 / 6
              3
```

7.5 TYPE 3:

The previous two types have illustrated the point that the number of digits on the right hand side of the answer must be equal to the number of zeros in the base. In case the number of digits exceed the number of zeros in the base, the excess digit is carried over to the L.H.S. However, if the multiplication of the deficit digits yields the R.H.S. having digits less than the number of zeros in the base, then we prefix the zeros to the R.H.S.so that the total number of digits is equal to the number of zeros in the base.

```
7.5.1 Multiply  102 x 103                     102 + 2
                                               103 + 3
                                              ---------
                                               105 / 06
                                              ----------
```

The R.H.S.= 3 x 2 = 6.Since the base 100 has two zeros. Therefore, we prefix one zero before 6 i.e. we write 06 as the R.H.S.

7.5.2 Illustrations:

```
     107 x 101             104 x 102             1010 x 1005

     107 + 7               104 + 4               1010 + 10
     101 + 1               102 + 2               1005 + 05
    ---------            -----------           -------------
     108 /07               106 /08               1015 /050 = 1015050

     10010 x 10101                          1099 x 1001

     10010 +10                              1099 + 99
     10101 +101                             1001 + 01
    -------------                         -------------
     10111 /1010 = 101111010                1100 /099 = 1100099
    -------------                         -------------
```

```
103 x 2312              The base as 100

 103 +  3
2312 + 2212
----------------
2315 /  36   = 2315 + 66/36 = 2381/36 = 238136
      66

103 x 13                Taking base as 10

103 + 93
 13 + 3
-------------
106 /  9    =  106+ 27/9 = 133/9 = 1339
      27
```

7.6 TYPE 4:

In the three types of problems discussed at least one of the numbers to be multiplied was just a little more than the certain power of 10 which was taken as a base. However, if the numbers to be multiplied are just a little below the base, the steps to be followed are just the same.(as already explained in previous cases).The only difference is that instead of cross addition for obtaining the L.H.S. of the answer we do the cross subtraction. However, the other rules regarding digit surplus and digit deficit are exactly the same.

7.6.1 Illustrations:

```
      9 x 6                          6 x 5

      9 - 1                          6 - 4
      6 - 4                          5 - 5
     ---------                      -------
      5 / 4                          1 /  0   =1 + 2/0 =3/0 = 30
     ---------                            2

  8 x 6        91 x 93          89 x 97        64 x 98

  8 - 2        91 - 9           89 - 11        64 - 36
  6 - 4        93 - 7           97 - 3         98 - 2
 -------      ----------       ----------     ----------
  4 / 8        84 / 63          86 / 33        62 / 72
 -------      ----------       ----------     ----------
  79 x 97      988 x 998        985 x 995      99976 x 99998

  79 - 21      988 - 12         985 - 15       99976 - 24
  97 - 3       998 - 2          995 - 5        99998 - 2
 ----------   -----------      ----------     -----------
  76/ 63       986 / 024        980 / 075      99974 /00048
 ----------   -----------      ----------     -----------
```

NOTE: Please note that the deviation of these numbers which are less than the base is obtained directly by using the Nikhilam Sutra.

Example 1: The deviation of the number 99976 from the base of 100,000 is obtained by Nikhilam Sutra, all from nine and last from ten. Therefore, 9- 9 = 0; 9 - 9 = 0, 9 - 9 = 0; 9 - 7 = 2; and 10 -6 = 4. Hence our deviation is -00024 etc.

Example 2: 96453; 9 - 9 = 0, 9 -6 = 3, 9 -4 = 5, 9 -5 = 4, 10 -3 = 7.
deviation is = - 03547

Example 3: 9954; 9 - 9 = 0, 9 -9 = 0, 9 - 5 = 4, 10 - 4 = 6
deviation is = - 0046

7.7 TYPE 5 :

If one of the multiplying numbers is more than the base and the other is less than the base, then the deficits shall be positive and negative respectively. The right hand side shall therefore, be negative and the same shall have to be subtracted from the L.H.S. for obtaining the answer.

7.7.1 Illustrations

13 + 3
9 - 1
____
12 / $\overline{3}$ = 11/10 - 3 = 11/7 = 117
____

106 + 6
96 - 4
____
102 / $\overline{24}$ = 101/100 - 24 = 101/76 = 10176
____

108 + 8
91 - 9
____
99 / $\overline{72}$ = 98/100 - 72 = 9828
____

103 + 3
97 - 3
____
100/ $\overline{09}$ = 99/100 -09 = 9991
____

1021 + 21
996 - 4

$1017 / 08\overline{4}$ = 1016/1000 -84 = 1016916

10012 + 12
9997 - 3

10009/0036 = 10008/10000 - 0036 = 100089964

NOTE: The right hand portion of the answer is with a -ve sign. It is called the Vinculum-portion'.Note that even the subtraction of the Vinculum portion can be easily done with the aid of the Sutra Nikhilam Navatascaramam Dasatah (all from nine and the last from 10).

DISCUSSION:

Further, it is very conveniently possible to use Nikhilam method even for multiplying numbers which are close to a sub-base. For base of 10, the sub-bases are 20, 25, 30, 40 and 50. We use the Anurupyena upsutra to modify the L.H.S. It is also possible even to multiply 2, 3 or 4 numbers in one line. We can use different bases at the same time which makes Nikhilam method very convenient and easy. Further details about these are available in the correspondence course lessons, and brief outline is being presented in Pushp II and III.

PROBLEMS:

Q. Complete the following multiplications :

(i) 12 x 12 (ii) 14 x 13 (iii) 17 x 17 (iv) 108 x 103
(v) 102 x 103 (vi) 112 x 108 (vii) 113 x 109 (viii) 112 x111
(ix) 1002 x 1009 (x) 1007 x 1012 (xi) 1110 x 1004
(xii) 1003 x 1002 (xiii) 19 x 17

Q.2 Perform the following multiplication by using `Nikhilam Sutra :

(i) 9 x 7 (ii) 8 x 7 (iii) 7 x 6 (iv) 6 x 5
(v) 91 x 93 (vi) 92 x 95 (vii) 87 x 97 (viii) 86 x 98
(ix) 58 x 99 (x) 67 x 96 (xi) 87 x 91 (xii) 598 x 998
(xiii) 99981 x 99998

Q.3 Obtain the `Vinculum portion and use the Nikhilam Sutra to perform the following multiplications:

(i) 11 × 9 (ii) 14 × 6 (iii) 111 × 98 (iv) 15 × 6

(v) 102 × 98 (vi) 125 × 95 (vii) 1025 × 997

(viii) 1034 × 998 (ix) 1002 × 92 (x) 1003 × 97

(xi) 100007 × 9998 (xii) 10008 × 9992 (xiii) 10002 × 9993

CHAPTER 8

NIKHILAM COROLLARIES

8.1 INTRODUCTION :

The previously illustrated examples were all solved by using the Nikhilam Sutra. Some of these examples can be more easily done by using Urdhva-Tiryagbhayam Sutra.This sutra is the general formula applicable for all types of multiplication.

However, there are a few more corollaries arising out of the Nikhilam Sutra discussed in the previous chapter. We shall first learn these corollaries before discussing the Urdhva Tiryagbhyam sutra.

8.2 THE FIRST COROLLARY

The first corollary of Nikhilam Sutra is Yavadunam Tavadunikritya Varganca Yojayet.It means what ever the extent of its deficiency lessen it further to that very extent; and also set up the square (of that deficiency).

This sutra essentially deals with squaring of the numbers.

8.2.1 Illustrations

Case 1: The numbers smaller than the base i.e. having -ve deficiency.

(i) Find the square of 6.

Step 1: Base 10 and the deficiency is -4.

Step 2: As 6 is 4 less than the base 10, we should further decrease it by its deficiency from the base i.e. 4 in this case. Therefore, 6 - 4 = 2.This is the L.H.S. of our answer. 2/

Step 3: The R.H.S. of the answer is obtained as the square of the deficiency. In this case $4^2 = 16$.

Step 4: Since the base is 10 only one digit is admissible on the R.H.S. and the extra digit we carry over as usual.

$$2/\,_{1}6 = 36$$

Similarly we can obtain

$7^2 = (7 - 3)/3^2 = 4/9 = 49$

$8^2 = (8 - 2)/2^2 = 6/4 = 64$

$9^2 = (9 - 1)/1^2 = 8/1 = 81$

Further we can extend the application of Yavadunam sutra to larger numbers

$92^2 = (92 - 8)/8^2 = 84/64 = 8464$

$94^2 = (94 - 6)/6^2 = 88/36 = 8836$

$95^2 = (95 - 5)/5^2 = 90/25 = 9025$

$96^2 = (96 - 4)/4^2 = 92/16 = 9216$

$97^2 = (97 - 3)/03^2 = 94/09 = 9409$

$99^2 = (99 - 1)/01^2 = 98/01 = 9801$

$996^2 = (996 - 4)/04^2 = 992/016 = 992016$

$993^2 = (993 - 7)/07^2 = 986/049 = 986049$

$995^2 = (995- 5)/05^2 = 990/025 = 990025$

$989^2 = (989 - 11)/011^2 \; 978/121 = 978121$

$987^2 = (987 - 13)/013^2 = 974/(13+3)/3^2 = 16/9 = 169 = 974169$

$9989^2 = 9989 - 0011/0011^2 = 9978/0121 = 99780121$

$9993^2 = 9986/0049 = 99860049$

8.2.2 Case 2: The numbers greater than the base i.e. having positive deficiencies.

$13^2 = 13 + 3/3^2 = 16/9 = 169$

Since the deficiency is +ve, therefore, the number is increased by the amount of the deficiency.

$16^2 = 16 + 6/6^2 = 22/\underset{3}{6} = 256$

$18^2 = 18 + 8/8^2 = 26/\underset{6}{4} = 324$

$20^2 = 20 + 10/10^2 = 30/\underset{10}{0} = 40/0 = 400$

$104^2 = 104 + 4/04^2 = 108/16 = 10816$

$107^2 = 107 + 7/07^2 = 114/49 = 11449$

$112^2 = 112 + 12/12^2 = 124/\underset{1}{44} = 12544$

$1011^2 = 1011 + 11/011^2 = 1022/121 = 1022/121 = 1022121$

COMMENT: The algebraic proof of these methods have also been presented by Jagatguru Swami Sri Bharati Krisna Tirthji Maharaj in his book on Vedic Mathematics.

8.3 THE SECOND COROLLARY

The second corollary is the Sutra Ekadhikena Purvena. This sutra is used as a subsutra in the present case. This is a special case of the first corollary, and is applicable for squaring the numbers having 5 as the last digit. It's meaning is 'by one more than the previous one

8.3.1 Square of 35.

Here the previous digit is 3. The sutra in this context tells us to multiply the previous digit (here 3) by one more than the previous number (3 + 1=4). Therefore, 3 x 4 = 12 is L.H.S.portion of the answer.The R.H.S.is simply the vertical multiplication product (5 x 5 = 25).

Therefore $35^2 = 3 \times 4/5 \times 5 = 1225$

8.3.2 Illustrations

$25^2 = 2 \times 3/25 = 6/25 = 625$

$45^2 = 4 \times 5/25 = 20/25 = 2025$

$65^2 = 6 \times 7/25 = 42/25 = 4225$

$85^2 = 8 \times 9/25 = 72/25 = 7225$

$75^2 = 7 \times 8/25 = 56/25 = 5625$

$95^2 = 9 \times 10/25 = 90/25 = 9025$

$115^2 = 11 \times 12/25 = 132/25 = 13225$

$$135^2 = 13 \times 14/25 = \begin{array}{l} 13 + 3\ / \\ 14 + 4\ / \\ \hline 18/\ 2\ / \end{array}\ 25 = 18225$$

$$145^2 = 14 \times 15/25 = \begin{array}{l} 14 + 4\ / \\ 15 + 5\ / \\ \hline 21\ /0\ / \end{array}\ 25 = 21025$$

$195^2 = 19 \times 20/25 \qquad = 38025$

$155^2 = 15 \times 16/25 = 240/25 = 24025$

$185^2 = 18 \times 19/25 = 342/25 = 34225$

8.4 A sub-corollary to this is Antyayor-Dasakopi. This sub-sutra indicates that the above rule is also applicable to the multiplication of two numbers whose previous part is same and the sum of the last two digits is 10. The details are presented in PUSHP-II.

8.5 THE THIRD COROLLARY

In mathematical astronomy we frequently require the multiplication of multiplier digits consisting entirely of nines with other numbers (multiplicand). For multiplication of this type the subsutra Ekanyunena-Purvena is used.

8.5.1 Case I: Multiply 6 x 9 .

According to the sutra the multiplicand has to be decreased by 1 (this gives the L.H.S) and for the R.H.S. subtract the L.H.S. from the multiplier. (get complements of nines).

Therefore 6 x 9 = (6 - 1)/ 9-(6-1) = 5/4 = 54

Illustrations

(i) 9 x 9 =(9- 1)/ 9-(9-1) = 9/1 = 81

(ii) 12 x 9=(12-1)/9-11 = $11/\bar{2}$ =10/10 -2 =10/8 =108

(iii) 13 x 99 = (13-1)/(99-12) = 12/87 = 1287

(iv) 19 x 99 =18/(99-18) = 18/81 = 1881

(v) 778 x 999 = 777/222 = 777222

(vi) 9863 x 999 = 9862/0137 = 98620137

COMMENT While obtaining the R.H.S. of the answer by subtracting the L.H.S. from the multiplier (9999) all the digits including zero must be written (9999 - 9862) = 0137.

(vii) 3728387 x 9999999 = 3728386/6271613 = 37283866271613

(viii) 12345678912 x 999999999 = 12345678911/87654321088

= 1234567891187654321088

8.5.2 Case II:

If the multiplicand is having a small number of digits than the multiplier, the Sutra Ekanyunena is equally applicable. It is necessary to fill in the blanks on the left with the required number of zeros. The remaining process is unaltered.

Further, if the number of 9s in the multiplier are smaller than the number of digits in the multiplicand we may face some difficulty in directly applying Ekanyunena Sutra. However the solution can still be obtained by using a small additional step, in which the Vinculum shall be used. The details about the same shall be covered in Pushp -II.

Discussions:

1. We have just seen three corollaries of the Nikhilam Sutra which work almost with a magic speed.

2. There are large number of other cases where specific Vedic methods provide the magic speed calculation procedure.

3. The detailed discussion of the subsequent corollaries shall be presented in further books.

PROBLEMS:

Perform the following multiplications. Indicate the Sutra or subsutra in ease.

Q.1 Squaring Numbers.

93 x 93 91 x 91 98 x 98 101 x 101 133 x 133

111 x 111 998 x 998 991 x 991 993 x 993

994 x 994 977 x 977 999 x 999 9797 x 9997

9991 x 9991 17 x 17 19 x 19 21 x 21 103 x 103

106 x 106 109 x 109 111 x 111 113 x 113 1009 x 1009

Q.2 35 x 35 55 x 55 75 x 75 105 x 105 125 x 125

165 x 165

Q.3 7 x 9 6 x 9 8 x 9 14 x 99 11 x 9 17 x 99

767 x 999 9367 x 9999 8437 x 9999

CHAPTER 9

THE GENERAL METHOD OF MULTIPLICATION

9.1 INTRODUCTION

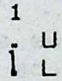
So far we have seen the use of the Vedic Sutras for the solution of specific types of problems. Now we shall learn the simple Vedic general method of multiplication. This method is based on the Urdhva-Tiryagbhyam Sutra.The simple meaning of this sutra is vertically and crosswise. But this sutra is very powerful and applicable for solving a large class of problems in mathematics. Further, it is interesting to point out that this brief sutra has many fold applications. Prof. Nicholas and Prof. Williams have written a full book on applications of this sutra (see news). The step-by-step process is outlined in the following sections :

9.2 SIMPLIFICATION

For understanding the application of Urdhva sutra,it is important to first learn the method of simplification of different numbers of columns.

Level 1: If there are only 2 digits in a single column we just multiply them vertically to get R the resultant number.

$$R = U1 \times L1$$



For example

$$\begin{array}{r} 2 \\ 3 \\ \hline \end{array}$$

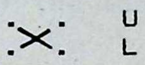
$$R = 2 \times 3 = 6$$

If however the resulting number consists of more than one digit, the extra digit at tenth place is written below the next higher space.

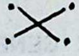
Level 2: If the simplification consists of two columns with four digits the resulting number is obtained by cross multiplication of the diagonally opposite digits and algebraic addition of the products.

U is the upper row

L is the lower row and U_1 and U_2 are the digits in the upper row in the 1st and 2nd column respectively.Similarly L_1 and L_2 are the digits of the lower row in column 1 and 2 respectively (from right).



Therefore $R = U_1 \times L_2 + U_2 \times L_1$

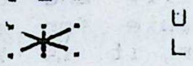


For example

21
32

Therefore $R = 1 \times 3 + 2 \times 2 = 7$

Level 3: If we are simplifying three columns with six digits the result shall be obtained by cross multiplying the outer column digits (column 1 and 3) and adding, we further add the product of the two digits of the central column (column 2).



Therefore $R = U_1 \times L_3 + U_3 \times L_1 + U_2 \times L_2$

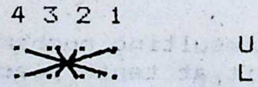
For example

1 2 3
1 2 4

$R = 3 \times 1 + 4 \times 1 + 2 \times 2 = 11$

The extra digit (1) shall be written below the next higher place.

Level 4: If we are simplifying four columns with 8 digits the result should be obtained as the summation of the four cross multiplications. The first two shall consist of the cross multiplication of the outer most two columns (1 and 4) and the remaining two shall be the cross multiplication of the inner two columns (nos. 2 and 3).



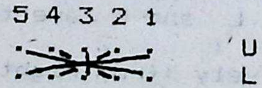
$R = U_1 \times L_4 + U_4 \times L_1 + U_2 \times L_3 + U_3 \times L_2$

For example

1 3 2 4
1 2 3 5

Therefore $R = 4 \times 1 + 1 \times 5 + 2 \times 2 + 3 \times 3$

Level 5: Similarly for 5 colums



$R = (U_1 \times L_5 + U_5 \times L_1) + (U_2 \times L_4 + U_4 \times L_2) + (U_3 \times L_3)$ etc.

9.3 THE PROCEDURE

After understanding the method of simplifying different number of columns we can now learn the step-by-step process of applying 'Urdhva Sutra' with the help of the following examples.

Step 1: Simplify the first column. We start with the extreme left hand column. This gives the extreme left hand digit of the answer

Step 2: We include the second column and simplify the two columns to get the second digit of the answer.

Step 3: Similarly we go on including one more column, in each step, and simplify to get the subsequent parts of the answer till the first column has operated upon all other columns. This would give us the result of the product upto the levels equal to the number in the digits being multiplied.

Step 4: For subsequent parts of the answer, starting from the first column we go on eliminating one column at each stage, and simplify the remaining columns, till we are left with the extreme left column, simplification of which gives us the extreme left part of the answer.

NOTE: In each of these simplifications if the result consists of more than one digit number, the surplus digit is written below the next higher level.

9.4 ILLUSTRATION 1:

Let us consider the multiplication of 2 by 2 digit numbers.

Multiply 13 x 21

$$\begin{array}{r} 2\ 1 \\ \times\ 1\ 3 \\ \hline 3 \end{array}$$

Step 1: We simplify the first column

$$R_1 = U_1 \times L_1 \qquad |$$

$$= 1 \times 3 = 3$$

$R_1 = 3$ is the extreme right part of the answer and is written below the first column.

Step 2: We operate the first column with each of the subsequent columns. We include the second column which on simplification gives the next digit.

$$R_2 = U_1 \times L_2 + U_2 \times L_1 \qquad \times$$

$$= 1 \times 1 + 2 \times 3 = 7$$

R_2 = 7 is the result at the next level and is written at the tenth level.

With this we complete the operation of the first column.

Step 3: We eliminate the first column and simplify the remaining columns (here only one column is left) therefore

$$R_3 = U_2 \times L_2$$

$$= 2 \times 1 = 2$$

R_3 = 2 is the resulting digit at the next level (hundred in this case). The result is written into appropriate level.

$$\begin{array}{r} 2\ 1 \\ \times \quad 1\ 3 \\ \hline 2/7/3 \\ \hline \end{array} \quad = \ 273$$

9.5 ILLUSTRATION 2:

Multiply 26 by 34.

$$\begin{array}{r} 3\ 4 \\ \times\ 2\ 6 \\ \hline /6/4 \\ 2\ 2\ \ \\ \hline \end{array}$$

Step 1: We simplify the first column

$$R_1 = U_1 \times L_1$$

$$= 4 \times 6 = 24$$

R_1 =24 the result is consisting of two digits. 4 is written at the unit place and the excess digit (here 2) is written below the next level.

Step 2: Include the second column and simplify

$$R_2 = U_1 \times L_2 + U_2 \times L_1$$

$$= 4 \times 2 + 3 \times 6 = 26$$

R_2 = 26, therefore 6 is written at the tenth place and the excess digit (here 2) is written below the next level.

Step 3: We eliminate the first column and simplify

$$R_3 = U_2 \times L_2$$

$$= 3 \times 2 = 6$$

$R_3 = 6$ is written at the next level.

Step 4: We add the carryover digits to the digits at the respective level

$$\begin{array}{r} 3\;4 \\ \times\;\; 2\;6 \\ \hline 6/6/4 \\ 2\;\;2\;\;\; \\ \hline 8\;8\;4 \;=\; 884 \\ \hline \end{array}$$

9.6 ILLUSTRATION 3:

Multiply 123 by 425

$$\begin{array}{r} 4\;2\;5 \\ \times\;\; 1\;2\;3 \\ \hline 1/6/5 \\ 2\;1\;1\;\; \\ \hline \end{array}$$

Step 1: Simplify the first column

$$R_1 = U_1 \times L_1 \quad = 5 \times 3 = 15$$

$R_1 = 15$ therefore 5 is written in the unit column and excess digit 1 is written below the tenth column.

Step 2: We operate the first column with the subsequent columns, advancing column by column.

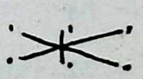
$$R_2 = U_1 \times L_2 + U_2 \times L_1$$

$$= 5 \times 2 + 2 \times 3 = 16$$

$R_2 = 16$ therefore 6 is written at the tenth place and excess digit is written below the hundredth column.

Step 3: We include the third column and simplify

$$R_3 = U_1 \times L_3 + U_3 \times L_1 + U_2 \times L_2$$

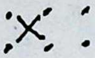


$$= 5 \times 1 + 4 \times 3 + 2 \times 2 = 21$$

therefore 1 is written at hundredth place and the excess number 2 is written below the next level. This completes the operation of the first column on remaining columns.

Step 4: We eliminate the first column and simplify the remaining columns to compute the next part of the answer

$$R_4 = U_2 \times L_3 + U_3 \times L_2$$

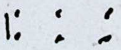


$$= 2 \times 1 + 4 \times 2 = 10$$

R_4 = 10 therefore 0 is the entered in the thousandth place and excess digit 1 is written below the next level.

Step 5: For the next level we eliminate the second column and simplify the remaining columns. In the present example we are left with only the third column.

$$R_5 = U_3 \times L_3$$



$$= 4 \times 1 = 4$$

R_5 = 4 is entered at the next level.

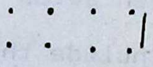
```
      4 2 5
      1 2 3
   -----------
   4/0/1/6/5
    1 2 1 1
   -----------
   5 2 2 7 5    =   52275
   -----------
```

9.7 ILLUSTRATION 4:

Multiply 7824 × 2638

```
       7824   U
  x    2638   L
     ----------
     /0/4/8/2
    10 9 2 3
     ----------
```

Step 1: Simplify the first column

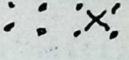


$$R_1 = U_1 \times L_1 = 4 \times 8 = 32$$

R_1 = 32 therefore 2 is written in the unit column and excess digit 3 is written below the tenth column.

Step 2: We operate the first column with the subsequent columns, advancing column by column.

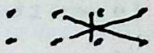
$R_2 = U_1 \times L_2 + U_2 \times L_1$



$= 4 \times 3 + 2 \times 8 = 12 + 16 = 28$

R_2 = 28, therefore 8 is written at the tenth place and 2 below the hundredth place.

Step 3: Now include the third column



$R_3 = U_1 \times L_3 + U_3 \times L_1 + U_2 \times L_2$

$= 4 \times 6 + 8 \times 8 + 2 \times 3 = 24 + 64 + 6 = 94$

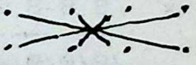
R_3 = 94, therefore 4 is written at hundredth place and 9 below thousandth place.

Step 4: Including the fourth column

$R_4 = U_1 \times L_4 + L_1 \times U_4 + U_3 \times L_2 + L_3 \times U_2$

$= 4 \times 2 + 7 \times 8 + 8 \times 3 + 6 \times 2 = 8 + 56 + 24 + 12$

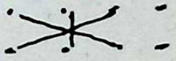
$= 100$



R_4 = 100 therefore 0 is written at thousandth place and the excess number 10 is written below the next level. This completes the operation of the first column on remaining columns.

Step 5: Eliminating the first column, we will simplify the remaining columns (from 2nd to 4th).

$R_5 = U_2 \times L_4 + U_4 \times L_2 + U_3 \times L_3$

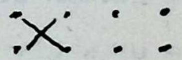


$= 2 \times 2 \quad 7 \times 3 + 6 \times 8 = 4 + 21 + 48 = 73$

R_5 = 73 therefore 3 is written at ten thousandth place and 7 below the next level.

Step 6: Further, eliminating the second column and simplifying the remaining two columns

$R_6 = U_3 \times L_4 + U_4 \times L_3$



$= 8 \times 2 + 7 \times 6 = 16 + 42 = 58$

R_6 = 58 therefore 8 is written at next level that is lakh, and 5 below the million level.

Step 7: Now simplifying the last column, (eliminating 3rd column also).

$R_7 = U_4 \times L_4$ = / × 2 = 14

R_7 = 14 written at the million place

```
          7 8 2 4
          2 6 3 8
      -------------
      14/8/3/0/4/8/2
       5/7/10/9/2/3/
      -------------
       2/0/6/3/9/7/1/2  = 20639712  Ans.
      ---------------
```

9.8 ILLUSTRATION 5:

Multiply 2427 × 8882

```
        2 4 2 7
     x  8 8 8 2
       ---------
        /8/0/0/4
     10/8/6/1/
```

Step 1: $R_1 = U_1 \times L_1 = 7 \times 2 = 14$

Step 2: $R_2 = U_1 \times L_2 + L_1 \times U_2 = 7 \times 8 + 2 \times 2 = 56 + 4 = 60$

Step 3: $R_3 = U_1 \times L_3 + U_3 \times L_1 + U_2 \times L_2$

$= 7 \times 8 + 4 \times 2 + 2 \times 8 = 56 + 8 + 16 = 80$

Step 4: $R_4 = U_4 \times L_1 + U_1 \times L_4 + U_3 \times L_2 + L_3 \times U_2$

$= 2 \times 2 + 7 \times 8 + 4 \times 8 + 8 \times 2$

$= 4 + 56 + 32 + 16 = 108$

Now the column elimination process is started.

Step 5: $R_5 = U_4 \times L_2 + L_4 \times U_2 + U_3 \times L_3$

$= 2 \times 8 + 2 \times 8 + 4 \times 8 = 16 + 16 + 32 = 64$

Step 6: $R_6 = U_3 \times L_4 + U_4 \times L_3$

$= 2 \times 8 + 4 \times 8 = 16 + 32 = 48$

Step 7: $R_7 = U_4 \times L_4 = 2 \times 8 = 16$

```
      2 4 2 7
      8 8 8 2
  --------------
  16/8/4/8/0/0/4
  4 1 0 8 6 1
    6
  --------------
  1 1 5 5 6 6 1 4    = 11556614
  --------------
```

9.9 DISCUSSIONS:

1. The 'Urdhava Sutra' gives us the key procedure for multiplying any two numbers. Once the method of simplification is properly understood and practised the remaining step by step procedure can be applied in a simple way. The whole process can be carried out through simple mental arithmatic.

2. After a little practice even the excess carry over digit obtained at any level need not be written down below the next higher level but instead is directly added to the simplification value of the columns at the next level. If this approach is used the final answer can be obtained in one line.

3. In Vedic method we can also start computing the answer from the left hand side. This method shall be explained in Pushp -2 alongwith the use of Vinculum approach.

PROBLEMS:

Solve all problems of Chapters 7 & 8 by Urdhava and compare.

CHAPTER 10

MULTIPLICATION CHECK

10.1 INTRODUCTION

In addition to the simplicity, speed and accuracy provided by the Vedic Mathematics for the multiplication process, it also has a unique feather in its cap. There is an extremely simple 'Vedic Method for checking the correctness of the multiplication results, using which even a middle standard student can check his calculations in less than 1 minute time.

10.2 PROCEDURE

The very simple, superfast and accurate procedure is outlined in the following steps with the help of an example.

10.2.1 Example 1:

Multiply 1006 x 1112

The 'Nikhilam Sutra is invoked (Refer chapter 7).

```
Therefore          1112 + 112
                   1006 + 006
                   ------------
                   1118 / 672     = 1118672
                   ------------
```

Step 1: Write down the multiplicand, multiplier and the result in three rows in the usual manner and draw a big square in front of it. Draw the two diagonals, there by dividing the inner space into 4 triangles.

Step 2: Add the digits of the multiplicand. If the addition exceeds 9, once again add the digits of the result of addition. Repeat this process till the final number is a single digit number.

In this example 1 + 1 + 1 + 2 = 5 is the resulting single digit. Write this number in the top triangle.

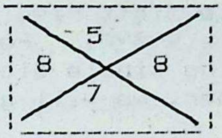
Step 3: Add the digits of the lower number i.e. the multiplier. If the addition exceeds 9, once again add the digits of the result of this addition. Repeat this process till a single digit number is obtained.

In the present example 1 + 0 + 0+ 6 = 7, the resulting single digit has been obtained in a single step.

Write this single digit number in the bottom triangle.

Step 4: Multiply the top single digit number in the top triangle with the single digit number in the bottom triangle. Write the result adjacent to the right hand side triangle.Add the digits of the resulting number.Write down this single digit number in the right hand side triangle.

```
 1 1 1 2
 1 0 0 6
----------
 1118672
----------
```



5 x 7 =35
3 + 5 = 8

Step 5: Add the digits of the total result of the multiplication. Once again if the addition exceeds 9, add these digits of the result of previous addition. Repeat this process till the final number is a single digit number. Write this single digit number in the empty space of left hand side triangle.

Step 6: CHECK

If the number in the left hand side triangle is equal to the number in the right hand side triangle.We can be reasonably sure that the multiplication result is correct.

In the present example, we get

1 + 1 +1 + 8 + 6 + 7 + 2 = 26; 2 + 6 = 8

We observe that the numbers in the right hand side triangle and the left hand side triangle are both equal to 8. This confirms the correctness of the multiplication.

NOTE: 1. This process may be further expedited by using the following steps :

(a) As the addition of the digits is being carried out, as soon as the addition exceeds 9, we can add this sub-result digits to transform them into a single digit number.We continue the further addition, using this single digit, as the sub-result.

In the present example 1 + 1 +1 + 8=11. 11 is the two digit sub-result of addition of the left hand side 4 digits. Therefore 1 + 1 = 2 is the simplified single digit sub-result. This will be used for further addition.

2 + 6 = 8
8 + 7 = 15

Once again, at this stage, we get a two digit number (15) as a sub-result. This is reduced to a single digit. Therefore 1 + 5 = 6.

This sub-result is carried forward for subsequent addition. Therefore 6 + 2 = 8 is the final resulting single digit number obtained.

(b) In case there are any nines (9) in any of the numbers (the multiplicand, multiplier and the result), this can be simply eliminated during the addition process, without alterning the final single digit result. This shall further simplify the already super simple process of checking. However, if any of these numbers consists entirely of nines and zeros, then only one nine should be retained, as the single digit result of the addition. Say for example the multiplier is 99090. Following this rule we can drop two nines and the resulting single digit number would be 9. Even if we add in the normal manner, we will get the same results.

9 + 9 = 18; therefore 1 + 8 = 9

9 + 0= 9

9 + 9 = 18; therefore 1 + 8 = 9

9 +0 = 9

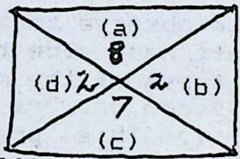
Quite obviously the 'Vedic Mathematics' procedure for checking of the multiplication is extremely simple wonderfully fast, yet quite accurate.

And at the top of it.

<u>Just 'a child's play'</u>

10.3 FURTHER ILLUSTRATIONS

10.3.1 Example 2:



Multiply 87965 x 99988

By applying Nikhilam we get the answer 8795444420.

Step 1:

```
   8 7 9 6 5
 x 9 9 9 8 8
 -----------
  8795444420    and draw a square with four equal
 -----------    triangles.
```

Step 2: Add the digits of multiplicand to get one single digit number.

8 + 7 = 15, 1 + 5 = 6; 6 + 0 = 6; 6 + 6 = 12, 1 + 2 =3;

3 + 5 = 8

Enter 8 in the upper triaangle (a).

Step 3: Add the digits of multiplier to get one single digit number

9 + 9 = 18, 1 + 8 = 9; 9 + 9 = 9; 9 + 8 = 8;

We may leave all 9's and procede

8 + 8 = 16, 1 + 6 = 7;

Enter 7 in the lower trianlge (c)

Step 4: Now multiply the digits of triangle's (a) and (c) i.e., 8 x 7 = 56 and convert this 56 into single digit 5 + 6 = 11, 1 +1 = 2.

Enter 2 in the L.H.S. triangle (b).

Step 5: Add the digits of the result to get one single digit number.

8+7 =15, 1 +5 =6; 6 +5 = 11, 1 +1 = 2; 2 +4 +4= 10, 1 + 0=1;

1 + 2 + 4 + 4 = 11, 1 + 1 = 2.

Enter 2 in the L.H.S. triangle (d).

Step 6: Here 2 =2.So our answer is correct.

PROBLEMS:

Are the following multiplications correct? Write True/False. Use multiplication check :

(i) 96 x 98 = 9408 (ii) 879 x 998 = 886082

(iii) 1016 x 1006 =1122096 (iv) 1033 x 977 = 1029901

(v) 87965 x 99988 = 8796324070 (vi) 128 x 672 = 86016

(vii) 635 x 502 =318740 (viii) 989 x 989 = 987121

(ix) 775 x 775 = 601625 (x) 1021 x 2103 = 2147163

(xi) 582 x 231 = 134542 (xii) 87265 x 32117 = 2802690005

(xiii) 817 x 332 = 271244

```
(xiv)   1234567809
      x 9999999999
      ----------------------
        1234567808/8765432191
      ----------------------
(xv)    999999997
      x 999999981
      ----------------------
        999999878/000000057
      ----------------------
```

CHAPTER 11

RECURRING DECIMALS

11.1 INTRODUCTION

The 'Ekadhikena Sutra' can also be used for computing the values of recurring numbers at magic speed. The Vedic method of computing the value of the recurring numbers is not only superfast but also very simple and easy. Here we shall just study some applications in specific type of problems. Further details about other types of decimals and fractions shall be taken up in latter volumes.

11.2 THE LAST DIGIT

11.2.1 Fractions with Last Digit of 9

First of all we shall take those fractions whose last digit of the denominator is 9; for example fractions like

$$\frac{1}{19}, \quad \frac{1}{29}, \quad \frac{1}{39}, \quad \frac{1}{49} \quad \text{etc.}$$

We know that for every recurring decimal the last digit of the denominator when multiplied with the last digit of the recurring decimal will always yield a product ending in 9. In all the examples just mentioned the last digit of the denominator is 9. Therefore the last digit of the recurring decimals shall be 1 in all these cases. This property therefore gives us the last (right hand) digit of the recurring fraction as 1. The numerator is 1, if it is some other digit, the last digit shall be same.

11.2.2 Denominators Ending in Other Digits

For vulgar fractions whose denominators are 7, 13, 17 etc. we can easily establish the last digit of the decimal equivalent. We use the same property which tells us that the product of the last digit of the denominator and last digit of the decimal equivalent shall always end in 9. Therefore, the denominators ending in 7, 3 and 1 must necessarily yield decimals ending in 7, 3 and 9 respectively (as 7 x 7 =49, 3 x 3 = 9 and 1 x 9 = 9).

In other words we can say that before using this Ekadhiken sutra, it is essential to make the last digit of denominator as 9, by multiplying both top and bottom by a common required digit. Then the Right most digit shall be same as diigit obtained as the modified numerator and operator key is just one more than the number before 9.

$$\frac{1}{13} = \frac{1}{13} \times \frac{3}{3} = \frac{3}{39}$$

Now Ist right most digit shall be 3 and the operator is 3 + 1 = 4 etc.

11.3 THE OPERATOR:

The operator key number for computing the value of the recurring decimal can be obtained by applying the simple 'Ekadhikena Sutra . The simple meaning of the Sutra 'Ekadhikena Purvena' is 'by one more than the pevious one . Thus for $\frac{1}{49}$ the operator key is one more than the previous digit 4. Therefore operator is 4 + 1 =5 similarly for $\frac{1}{39}$ the operator = 3 +1 = 4, for $\frac{1}{29}$, operator = 2 + 1 = 3, for $\frac{1}{19}$,operator =1 + 1 =2 etc.

11.4 THE PROCEDURE:

'Ekadhikena Sutra tells us that 'by one more than the previous one'.The first word' by is used both for multiplying and dividing. It is interesting to learn that this operator key can be used in both ways to compute the value of the recurring decimal.We shall first of all learn the method of using the operator key as a constant uniform multiplier.

11.4.1 Illustration 1:

Let us take the fraction $\frac{1}{39}$.

As already explained the last right hand most digit shall be 1. Further, the operator key is 3 + 1 =4.The subsequent step by step procedure is outlined below.

Step 1: Put 1 as the extreme right digit and put a dot over it to ind e that it is the end of the set of recurring digits.

Step 2: We multiply this digit by the operator and write down the result towards the left hand of the previous digit. If the resulting number has more than one digit we put down the extra digit below the next level.In this case 1x 4 = 4 is written on the L.H.S. of 1 (the previous digit).

$$4\ \dot{1}$$

Step 3: We multiply the previous digit (4) by the common constant operator key number (here 4). Therefore 4 x 4 = 16. We write down 6 on the L.H.S. of previous digit 4 and excess digit 1 in the following manner (below the next level).

$$\begin{array}{ccc}6&4&\dot{1}\\1&&\end{array}$$

Step 4: We multiply the previous digit (6) by the operator 6 x 4 = 24 and add carry over digit 1 to yield the result 24 +1 = 25.Once again we write 5 on L.H.S. of the previous digit 6 and excess digit 2 below the next level.

$$\begin{array}{r} 5\;6\;4\;\dot{1} \\ 2\;1\phantom{\;4\;\dot{1}} \end{array}$$

Step 5: We multiply the previous digit (5) by the operator, 5 x 4 = 20 and add carry over digit 2 to the result 20 + 2 =22. The result is written as before.

$$\begin{array}{r} 2\;5\;6\;4\;\dot{1} \\ 2\;2\;1\phantom{\;6\;4\;\dot{1}} \end{array}$$

Step 6: We multiply the previous digit 2 by the operator (4), therefore 2 x 4 = 8 and add the carry over digit 2 to 8, so 2 + 8 =10. So our result will become

$$\begin{array}{r} 0\;2\;5\;6\;4\;\dot{1} \\ 1\;2\;2\;1\phantom{\;6\;4\;\dot{1}} \end{array}$$

Step 7: We multiply 0 x 4 = 0 and add the carry over digit 1 so 0 + 1 = 1 etc.So we find that we have started getting the same digits after 0. Therefore, we can put a dot over 0 to indicate that the set of recurring decimals starts from 0. The decimal is placed before 0.Thus the set of recurring decimal is

$$\frac{1}{39} = 0.\dot{0}2564\dot{1}$$

Discussion:

Since 39 is a prime number,the behaviour of $\frac{1}{39}$ is different from other recurring numbers.Let us consider the example of the recurring number $\frac{1}{29}$. As our next illustration.

11.4.2 Illustration 2:

Evaluate $\frac{1}{29}$.

Step 1: Here again since the last digit of the denominator is 9, the last digit of the decimal equivalent shall end in 1.

Step 2: The operator key by Ekadhika Sutra is equal to 'One more than the previous digit'. Here 2 +1 =3 is the constant, uniform multiplier.

Step 3: The operation:

(i) Put 1 as the last right digit.

(ii) Multiply the previous digit by the operator key 1 x 3 =3 and write the result before the previous digit (1).

$$3\;\dot{1}$$

(iii) Multiply the previous digit (3) by the operator (3) and write down before the previous digit (3), therfore 3 x 3 = 9.

$$9\;3\;\dot{1}$$

(iv) Further multiply the previous digit (9) by the operator (3) 9 x 3= 27 this results in a two digit number. As already explained we write down the unit place digit (7) before the previous digit (9) and the excess carry over digit (2) is written below the next level.

$$793\dot{1}$$
$$2$$

(v) Now we multiply 7 with operator 3 and get 7 x 3 =21. But since there is 2 carry over already written below, we add it to the product obtained.Therefore 21 +2 = 23. Once again the resulting number has two digits and the excess digit is written below next place.

$$3793\dot{2}$$
$$2\ 2$$

(vi) Similarly we go on computing the remaining digits till the digits start repeating. In case of 1/29 we shall get 28 digits as the result but in Vedic method the property of numbers is so thoroughly understood, so that even this simple operation of multiplying 28 times need not be carried out. There is a simpler way of writing down the remaining half of the result, after the first half has been computed. As soon as we obtain the result equal to the difference of the denominator and the numerator, we can be sure that half of the result has been just obtained with the previous digit. Therefore we put a slash just before the previous digit to indicate that half of the resulting digits have already been written. We can straight away write down the remaining digits towards the left hand side of slash by simply writing the complements of existing digits from 9. In the present example we obtain 19 as the 14th product. Therefore 9 is written as the 14th digit and excess digit 1 is written below the next level. Now when we multiply 9 with 3 we get 9 x 3 = 27 and add the carry over 1, 27 + 1 28 this result is equal to 29 - 1 = 28. Therefore, we put a slash before 9. The digits on the L.H.S. of slash are obtained by simply subtracting the corresponding digits already obtained from 9. Therefore 9 -1 = 8 is the 15th digit, 9- 3 =6 is the 16th digit, 9- 9= 0 is the 17th digit etc. and finally 9 -9=0 is the 28th digit.Therefore we put a dot over 0 and a decimal point before it.

$$.\dot{0}344827586206 8/96551724137 93\dot{1}$$
$$21\ 11\ 2\ 1\ 122$$

11.5 Illustration 3:

Let us take vulgar fraction not ending in 9. Say $\frac{1}{7}$.

Step 1: We put down 1/7 as 1/7 x 7/7 = 7/49.

Step 2: The operator here by 'Ekadhika Sutra' is 4 +1 = 5.

Step 3: Here our starting digit is 7.

Step 4: We multiply the previous digit (7) by the operator (5) and get 35. 5 is written before the previous digit and three below the next number.

Step 5: Next multiply 5 by 5 and add the carry over 3 to it. We get 28.

Step 6: Now multiply 8 by 5 and add 2 we get 42. But denominator-numerator (49 − 7) is also 42. Hence we stop the calculations and put a slash before the three digits already obtained.

2/ 8 5 7
2/ 3

Compute the remaining digits by obtaining the complements from 9 of already obtained three digits. Therefore, 9 − 7 =2 is the 4th digit, 9 − 5 =4 is the 5th digit and 9 − 8= 1 is the 6th digit. Hence our answer is $\frac{1}{7} = .\dot{1}4285\dot{7}$.

NOTE: Starting from the left hand side digit, the same result would be obtained if we start dividing numerator by the operator key. In this case of division we can stop at any level desired.

Discussions:

1. In this chapter we have studied very interesting, easy and simple applications of 'Ekadhika Sutra .

2. The speed with which the computations of recurring numbers are done looks almost like a magic compared with the present long, tedious and time consuming method.

3. Further, this system is very simple and easy.

4. In this case also the Vedic Method leaves behind the electronic calculators as the ordinary calculators shall not be in a position to compute more than 10 to 12 digits.

5. Further, the Vedic methods for any division, factorisation, solution of higher order equations are equally fast, simple and easy and shall be dealt with in later volumes.

6. In addition to these methods of solving varied class of problems the Vedic methods for checking the correctness of answer obtained, are also available.

PROBLEMS:

Q. Compute the following :

(i) 1/49 (ii) 1/13 (iii) 1/69 (iv) 1/17

(v) 1/59

CHAPTER 12

MULTIPLE CHOICE

12.1 NUMBERS :

Vedic Mathematics provides multiple choice for almost everything which we have to do. This makes maths a playful and lively subject which children learn with smiles. Even while handling numbers we have a choice to use the numbers or their complements.

For example $9 = 10 - 1 = 1\bar{1}$

$8 = 10 - 2 = 1\bar{2}$

$19 = 20 - 1 = 2\bar{1}$ etc.

Further, if instead of using 19 we use $2\bar{1}$, it is far more easier, simpler, faster and has lesser chances of error.

12.2 ADDITION:

For adding 8 to 9 we can either add in the usual way or we can add 8 to the complement of 9 ($1\bar{1}$) and get $8 + \bar{1} = 7$ at the unit place and 17 is the result. Similarly for adding 7 to 8, in addition to the normal way we can also add 7 to the complement of 8 ($1\bar{2}$). At unit place $7 + \bar{2} = 5$ and 15 is the result. Small children may find it simpler to reduce 8 by 1 then to add 8 to 9 (Refer Chapter 4).

12.3 SUBTRACTION:

This can be simply looked as a simple addition of the first number with bar put on all the digits of the number to be subtracted. Again as already illustrated, the process of Shudhikaran can be avoided most of the times by computing the result in the Vinculum form (Refer Chapter 5). Further details are available in Pushp 2.

$$\begin{array}{r} 3\ 2\ 7\ 4 \\ -\ 1\ 4\ 5\ 5 \\ \hline 2\ \bar{2}\ 2\ \bar{1} \\ \hline \end{array} \quad = 1819$$

12.4 MULTIPLICATION:

Even for the simple problem of multiply two numbers, Vedic Maths provides a large number of alternative ways of computing the result. This makes maths a playful subject. Students always like to play games and anybody with whom we play games, we naturally become friendly. And there is no fear or anxiety with a friend.

Example: Multiply 89 x 99

This typical example can be solved in seven different ways.

(i) The easiest solution can be obtained by applying Ekanuyena sutra (Refer Chapter 9).

```
89 x 99 = 89 - 1 /99 -88

        = 88 / 11  = 8811
```

(ii) We can use the Nikhilam method with ease and simplicity (Refer Chapter 7).

```
89 - 11
99 - 01
---------
88 / 11      =  8811
---------
```

Even here the L.H.S. can be obtained in four different ways.

(iii) We can use the Urdhva sutra and compute the results from right to left (Refer Chapter 10).

```
  89
  99
----------
88   1  1      = 8811
 /16 /8
----------
```

This is the most difficult way and a student ofVedic Maths shall never use this method. But it is interesting to point out that this method is closest to the only method being taught and used by all of us.

(iv) The Urdhva sutra can also be used to compute the result from left to right in two steps.

```
  89
  99
----------
72/  3/ 1      = 8811
 / 15/ 8
----------
```

After a little practice even left to right computations can be done in one line.

(v) It will be much more convenient and easy to first convert the given numbers in their Vinculum form and then apply the Urdhava sutra (refer Chapters 3 & 10). Further details are available in Pushp-2.

$$\begin{array}{l} 89 \ - \ 1\ \bar{1}\ \bar{1} \\ 99 \ - \ 1\ 0\ \bar{1} \\ \hline \\ 1/\bar{1}/\bar{2}/1/1 \qquad = 1\ \bar{1}\ \bar{2}\ 1\ 1 = 8811 \\ \hline \end{array}$$

It is interesting to observe that there is absolutely no carry over in the entire operation.

(vi) After converting these numbers in the Vinculum form, themultiplication using Urdhava sutra can be done with equal ease and simplicity even from left toright.

$$\begin{array}{l} 1\ \bar{1}\ \bar{1} \\ 1\ 0\ \bar{1} \\ \hline 1/\bar{1}/\bar{2}/1/1 \\ \hline \end{array} \qquad 1\ \bar{1}\ \bar{2}\ 1\ 1 \quad = 8811$$

(vii) The Nikhilam method can also be employed after converting the numbers in their Vinculum form (Refer Chapters 3 & 7).

$$\begin{array}{l} 1\ \bar{1}\ \bar{1}\ \ +\ \bar{1}\ \bar{1} \\ 1\ 0\ \bar{1}\ \ +\ 0\ \bar{1} \\ \hline 1\ \bar{1}\ \bar{2}\ /\ 1\ 1 \\ \hline \end{array} \quad = 1\ \bar{1}\ \bar{2}\ 1\ 1 \qquad = 8811$$

12.5 DISCUSSION:

Vedic system provides large number of choices in almost every thing we want to do.The very first step is to recognize the pattern and pick up the most efficient method. This task of pattern recognition alongwith mental working activates the righthalf of the brain which has the capability of intution.Thus,with the regular practice of Vedic Maths and its most natural mental procedures, the hollistic development of the human brain automatically takes place.Within a couple of years,we shall naturally develop the intutive faculty -the most powerful facet of the human personality, which unfortunately remains undeveloped in most of the cases.

PROBLEMS:

Q. Multiply the following and compare different alternative methods.

(i) 86 × 99 (ii) 817 × 989 (iii) 988 × 992

(vi) 372 × 418 (v) 2893 × 179

CHAPTER 13

GLIMPSES

INTRODUCTION:

The Ancient Vedic Mathematics is a vast subject and PUSHP I and II provide Vedic methods for Arithmetical operations. The applications in higher mathematics have already been revived in many areas. The pioneering book on Vedic Maths by Shankracharya Ji gives VM applications to algebraic operations, factorisations, simple quadratic and higher order equations, simultaneous quadratic equations, partial fractions, calculus, squaring; cubing, square root, cube root, coordinate geometry etc. etc. The recent research in U.K. includes applications of Vedic Mathematics to trignometry, three dimensional coordinate geometry, solution of plain and spherical triangles, linear and non linear differential equations, matrices and determinants, log and exponentials etc.

In one of the recent five publications from U.K., Prof. K. WILLIAMS in his book, Discover Vedic Mathematics, has solved the complete mathematics papers of G.C.E. A-level and O-level examinations of U.K., there by demonstrating that the entire mathematics upto our 10 + 2 system can be done by using Vedic methods. The three English Professors in their recent publication Vertically and Crosswise (Refer list of new books in VM News) have demonstrated how the Vedic 'URDHAVA SUTRA' alone can be used for solving a very large class of problems including evaluation of trignometrical functions and their inverse, logarithm, exponentials, higher order equations, partial differential equation and integral differential equation. Details of these are planned to be published in future PUSHPS of this PUSHPMALA. A few glimpses are presented in the following sections.

ARITHMETICAL OPERATIONS:

1. Compound Multiplication:

Find area of a rectangle of size 8 ft 11 inch by 11 ft 7 inch.

```
  8 ft    11 in.
 11        7
-----------------
88 /1 7 7 /7 7    = 103 /41
                  = 11 sq.yds 4 sq.ft 41 sq.inches
```

Sutra employed:- Urdhva Tiryagbhyam.

2. Perform following Divisions:

(i) 5 4 3 9 2 1 by 8 3

Sutra employed:- Dhvajanka and Urdhva Tiryagbhyam.

```
  3 : 5 4 3 9 2 / 1/
8       6 5 4 3
--------------------
        6 5 5 3 /2 2 / Hence quotient is 6553 and remainder is 22
```

(ii) 1 2 1 3 5 2 5 6 by 9 8 8 8

Sutra employed:- 'Nikhilam'.

```
9888/1 2 1 3 / 5 2 5 6
0112   0 1 1    2
         0 2    2 4
           0    2 2 4
                0 6 6  1 2
--------------------------
1 2 2 6/1/2 5 6 8
          0 1 1 2
--------------------------
1 2 2 7 / 2 6 8 0  Hence quotient is 1227 and remainder is 2680.
```

3. Express:- $\frac{17125}{59999}$ as a decimal upto 20 places.

By Vedic Sutra:- Ekadhikena Purvena

$$\frac{17125}{59999} = 0.28542142369039483991$$

4. Solve the fraction $\frac{243}{1601}$

$$\frac{243}{1601} = .151780137414116179$$

5. Find square root .0009240160 upto 5 places of decimals.

```
6 : 00 : 09 : 2 4 0 1 6 0
  :    :    : 0 2 6 6
---------------------------
  : 0  : 3  : 0 3 9 7 ....
```

6. Find the cube root of 33, 076, 161 in three steps we get

```
331 0761 161
           1
--------------
33  076  16
          6
--------------
33 0761
             Cube root = 321
```

ALGEBRAIC APPLICATIONS

7. Find Quotient and Remainder in following division, by Vedic Sutra- Paravataya-Yojavet.

$$\frac{x^3 - x^2 - 7x + 4}{x - 3}$$

Quotient = $x^2 + 2x - 1$. Remainder = 1

8. Solve Equation : By Vedic Sutra - Shunyam Samya Samuchchya.

$$\frac{1}{x+3} + \frac{1}{x-8} = \frac{1}{x+4} + \frac{1}{x-9};$$ Answer $x = 5/2$

URDHVA SUTRA APPLICATIONS:

Recently the Urdhva Sutra has been applied tosolve a large class of problems. (Refer List of Books).

9. Determinants

Evaluate -

$$\begin{vmatrix} 2 & 6 & 7 \\ 5 & 4 & 8 \\ 3 & 1 & 9 \end{vmatrix}$$

$$-7 \quad -21 \quad 28 = -119$$

Here Urdhva Sutra is used.

10. Solution of Simultaneous Equations:

$$\begin{array}{r|lr|r} -8 & 4x-2y & +3z = 8 & -5 \\ 14 & 2x-3y & + z = 1 & -17 \\ 13 & 3x+2y & - z = 3 & 4 \end{array}$$

$\therefore$ D = 33; x.D = 33; -y.D = -33; z.D = 66

where x = y = 1; z = 2. Sutra (No.3) is used.

11. Curve Fitting:

Find a quadratic passing through 3-points (8,7), (6,5) & (9,4) Changing origin to (6,5), we get (2,2), (0,0) & (3, -1)

If equation is $Y = AX^2 + BX$

(or) $6y = -8x^2 + 118x - 390$

12. Evaluate using Urdhva Sutra

$B = \exp(23.51)$

$B = \exp(23.51) = 1.62279 \times 10^{10}$

13. Find the roots of the biquadratic equation

$$x^4 - 20x^3 + 137x^2 - 382x + 360 = 0$$

using lopanasthapana sutra in four steps we get

$x = 5, 4, 2$ or 9.

These are just a few stray examples & illustrations only.

ANSWERS OF SELECTED PROBLEMS

C-1

Q. 1. (a) 107 +7 (b) 12 + 2 (c) 97 - 3 (d) 19 + 9 (e) 112 + 12

(f) 975 - 25 (g) 10008 + 8 (h) 89 -11 (i) 75 -25 (j) 29 + 19.

Q. 2. (i) Correct (ii) Correct (iii) Correct (iv) Wrong

(v) Wrong (vi) Wrong (vii) Wrong

Q. 3. (i) 13 +3 (ii) 7 - 3 (iii) 97 - 7 (iv) 1014 + 14

(v) 81 - 19 (vi) 99969 - 3 (vii) 1374 + 374

C-2

Q. 1. Operators arefollowing :

	Hundred,	Tenth	,Unity			Hundred,	Tenth,	Unity
(i)	0 ,	1 ,	-2	(ii)		0 ,	2 ,	-2
(iii)	0 ,	+1 ,	+3	(iv)		0 ,	3 ,	2
(v)	+1 ,	0 ,	+2	(vi)		1 ,	+2 ,	3
(vii)	+2 ,	+1 ,	+1	(viii)		+2 ,	-1 ,	+2
					Thousand			
(ix)	+2 ,	-2 ,	2	(x)	+1 ,	0 ,	0 ,	-2

Q. 2. Operators are

(i) -1 , -1 , -2 ; (ii) 3 , -2, -1; (iii) +3, +2, +2;

(iv) +1, +1, +2, +1 (v) 2, -2, +2 , -1

C-3

Q. 1. (i) $3\ \bar{0}\ \bar{2}$ (ii $1\ \bar{4}\ 3$ (iii) $1\ \bar{0}\ \bar{3}\ 1$ (iv) $2\ \bar{4}\ 2\ \bar{2}$

(v) $3\bar{0}\bar{1}\bar{3}1\bar{4}$ (vi) $2\bar{1}2\bar{2}2\bar{4}$ (vii) $5\bar{1}\bar{0}\bar{1}03\bar{1}1$ (viii) $1\bar{1}1\bar{2}4\bar{4}3\bar{2}1$

(ix) $1\bar{0}\bar{0}\bar{1}11\bar{1}\bar{1}2$ (x) $1\bar{1}1\bar{1}12553\bar{3}\bar{2}32$ (xi) $1\bar{1}235\bar{4}\bar{3}1$

Q.2. (i) 131 (ii) 6888 (iii) 2487 (iv) 0770891 (v) 1319553

(vi) 21039874 (vii) 48082681 (viii) 48798806

(ix) 459718090 (x) 496827463 (xi 49965193.

C-4

Q. 1. (i) 21000 (ii) 196217 (iii) 1997574 (iv) 27311429

(v) 204119404 (vi) 192668819

Q. 2. (i) 202 (ii) 276 (iii) 2352 iv) 41779

Q. 3. (i) 221 (ii) 36414 (iii) 2250 (iv) 1095

Q. 4. (i) Correct (ii) Wrong (iii) Wrong (iv) Wrong

Q. 5. (i) $\dot{0}\dot{8}\dot{4}7\dot{7}$, 45686 (ii) $\dot{9}\dot{7}\dot{3}\dot{6}\dot{3}$, 123872

C-5

Q. 1. (i) 08 (ii) 209 (iii) 168 (iv) 399 (v) 639

(vi) 4676 (vii) $\bar{4}0414$ (viii) 84123 (ix) 18889

(x) 594199 (xi) 611222 (xii) 1235679 (xiii) 09181089

(xiv) 000000001

Q. 2. (i) Incorrect ,03 (ii) Incorrect, 52 (iii) Correct, 9

(iv) Incorrect, 11 (v) incorrect, 10

Q. 3. (ii), (iii) needs Shudhikaran

Q. 4. (i) Incorrect (ii) Correct (iii) Correct (iv) Incorrect

(v) Correct

C-6

Q. 2. (i) Correct (ii) Correct (iii) Wrong (iv) Wrong

C-7

Q. 1. (i) 144 (ii) 182 (iii) 289 (iv) 11772 (v) 10506

(vi) 12096 (vii) 123317 (viii) 12432 (ix) 1011081

(x) 1019084 (xi) 114440 (xii) 1005006 (xiii) 323

Q. 2. (i) 63 (ii) 56 (iii) 42 (iv) 30 (v) 8463

(vi) 8740 (vii) 8439 (viii) 8428 (ix) 5742

(x) 6432 (xi) 7917 (xii) 596804 (xiii) 999790038

Q. 3. (i) 99 (ii) 084 (iii) 90 (iv) 10878 (v) 9894

(vi) 11075 (vii) 1021925 (viii) 1031932 (ix) 92184

(x) 97291 (xi) 999869986 (xii) 99999936 (xiii) 99949986

C-8

Q.1. (i) 86/49 (ii) 8281 (iii) 9604 (iv) 10201

(v) 17689 (vi) 12321 (vii) 976144 (viii) 982081

(ix) 986049 (x) 988036 (xi) 954522 • (xii)9981000

(xiii) 99940009 (xiv) 99820081 (xv) 289 (xvi) 361

(xvii) 531 (xviii) 10609 (xix) 11236 (xx) 11881

(xxi) already solved (xxii) 12769 (xxiii) 1018081

Q. 2. (i) 1225 (ii) 3025 (iii) 5625 (iv) 11025 (v) 15625

(vi) 27225

Q. 3. (i) 63 (ii) 54 (iii) 72 (iv) 1386 (v) 99

(vi) 1683 (vii) 766233 (viii) 93660633 (ix) 84361563

C-10

(i) Right, (ii) False (iii) False (iv) False

(v) True (vi) True (vii) False (viii True

(ix) False (x) True (xi) False (xii) True

(xiii) True (xiv) True (xv) False

FUTURE OF VEDIC MATHEMATICS

Future Research : There are almost infinite number of applications of Vedic Mathematics in different branches of science and technology. Prof. Andrew Nicholas of Polytechnic of North London foresees very bright future for Vedic Mathematics. In addition to the topics already listed under the VM News, Revered Bharti Krishen Tirthji Maharaj has mentioned about the Vedic methods for solving problems of interest, Statics, Dynamics, Hydrostatics,Pneumatics, Applied mechanics, Solid Geometry, Plain and spherical trignometry and Astronomy etc.etc. Dr. Verma of Delhi has recently informed that Revered Swamiji had delivered a series of 12 lectures on Vedic Mathematics for Fluid dynamics aspects of Aero-nautics.

It seems that what is available today in Vedic Mathematics is only a small visible tip above the water surface, of the huge ice berg floating in sea.

These require dedicated research work to rediscover the hidden treasures.

The feedback from those who have learnt Vedic Mathematics in a nutshell brings out that :-

1. VM converts the tedious mathematics into an interesting and playful subject, which children learn with smiles. Therefore Vedic Maths has the inherent qualities to eliminate the problem of 'MATHS ANXIETY' being faced in Maths education,all over the world.

2. Participating teachers and children often ask why VM is not being taught in every school and college,all over the world.

3. Vedic Maths system has the capacity for the HOLLISTIC DEVELOPMENT OF THE HUMAN BRAIN.

This task of developing and spreading Vedic Mathematics in all parts of the world requires the dedicated efforts of the lovers of the humanity, who have 'Shradha' for Ancient Vedic Cultural heritage,which is not only the oldest but also the noblest.

ANCIENT VEDIC MATHEMATICS

PUSHP MALA:- With a view to provide the comprehensive details of this wonderful Ancient Bhartiya Cutural Heritage SSS is planning to publish the PUSHP MALA of Vedic Maths. PUSHP -1 and 2 have already been published in English and Hindi.

The SSS most prayerfully and humbly announces the planned publication of the PUSHP -3 in English and Hindi in near future.

INVITATION

You are most cordially invited to participate in this Gyan Yagya (homa of knowledge) by giving Ahuti (donation) of your precious time. You can do as many of the following as convenient.

- Spreading the news of Vedic Mathematics.

* Chatting about VM when you are amongst unknown people.
* Giving small illustrations of the superfast cases to interested students, teachers and persons.
* Informing all that Vedic Maths is a complete scientific system.
* Giving demonstration lectures in your near by institutions.
* Organising the short VM courses at your place.

- Spreading the Vedic Mathematics Literature.

* Gifting VM books to your kith and kin.
* Gifting VM literature to the libraries in your area.
* Gifting VM books as prizes at the functions, you organise.

- Developing Vedic Mathematics.

* Collecting the ancient superfast computational procedures and literature and sending to/or/informing SSG.
* Applying Vedic Sutras to solve the problems of different sciences and sending to SSG for compilation and publication.
* Meditating on Vedic Sutras and further developing them and their applications.

SSG is meant to assist you in this 'Yagya'. This activity according to Vedanta shall decidedly help us in cleaning our mind and then the SELF within shall automatically stand revealed to the self.

HOLLISTIC DEVELOPMENT OF HUMAN BRAIN

According to the brain specialists the left half of the brain, systematically collects the information, does sequential analysis and arives at the logical conclusions and results. Only left half of the brain is activated and developed by the present Maths education, being given in the schools and colleges. The right half of the human brain works with pattern recognition and has the capability of intution. This most powerful facet of human personality -the intutive faculty, unfortunately, remains undeveloped in most of the students. In Vedic Mathematics system, the very first step is to recognize the pattern of the problem and pick up the most efficient Vedic algorithm. Further, at each subsequent step, we recognize the pattern and complete the task by using the appropriate superfast, mental working procedure. As in Vedic Maths we have multiple choices available at each stage of working. This practice, systematically develops the right half of the brain as well. As such by the regular practice of the most natural mental procedures of Vedic Maths system, the hollistic development of the human brain automatically takes place. In a nutshell we can say that the Vedic Maths provides the cosmic software for the cosmic computer (the human mind), so that the later is not wasted.

MATHEMATICS WITH SMILES

Vedic Mathematics has originated from the Ved. Ved is all divine knowledge. Any knowledge derived from the Ved is bound to have the touch of the divine bliss. Therefore, the very natural, easy and superfast algorithms of Vedic Mathematics bring an upsurge of joy and bliss. Due to its very special and universal features. Vedic Maths system converts the dry and tedious Maths into a playful and joyful subject, which children learn with smiles.

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